FIFTY-EIGHTH ANNUAL REPORT

OF THE

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

R. Y. WINTERS, Director

THE NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING OF THE UNIVERSITY OF NORTH CAROLINA

AND

STATE DEPARTMENT OF AGRICULTURE COOPERATING

STATE COLLEGE STATION
RALEIGH

FOR THE FISCAL YEAR ENDING JUNE 30, 1935
PROGRESS REPORT FOR YEAR ENDING
DECEMBER 1, 1935

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STATE INSTITUTIONS COOPERATING IN AGRICULTURAL RESEARCH

THE UNIVERSITY OF NORTH CAROLINA
STATE COLLEGE OF
AGRICULTURE AND ENGINEERING
State College Station, Raleigh, N. C.

FRANK P. GRAHAM, *President.*
J. W. HARRELSON, *Dean of Administration.*
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NORTH CAROLINA DEPARTMENT OF AGRICULTURE
Raleigh, N. C.

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F. E. MILLER, *Director of Test Farms**

*The six test farms are owned and operated by the North Carolina Department of Agriculture, and the employees on these farms are members of the Department of Agriculture staff.

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of the

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*F. E. Miller — *Director of Branch Stations*
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A. F. Bowen — *Treasurer*

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G. R. Smith — *Assistant in Cotton Marketing, in Cooperation with U. S. Department of Agriculture*

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R. E. Stitt — *Assistant Agronomist, U. S. Department of Agriculture*

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E. H. Hostetler — *Beef Cattle, Sheep and Swine Investigations*
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F. H. Smith — *Assistant in Animal Nutrition*
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R. F. Poole — *Plant Pathologist*

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Robert Schmidt — *Associate Horticulturist*
C. F. Williams — *Associate Horticulturist*
Ivan D. Jones — *Associate Horticulturist*

Poultry

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R. E. Greaves — *Assistant Poultry Investigator and Pathologist*
H. C. Gauger — *Assistant Poultry Investigator and Pathologist*
H. P. Brigman — *Statistical Assistant*

Zoology and Entomology

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Central Station

R. J. Harris — *Assistant Director in Charge*

*Branch Stations

Blackland Test Farm—Wenona

J. L. Rea, Jr. — *Assistant Director in Charge*
A. P. Lefevers — *Foreman*
Bryan Harris — *Herdsman*

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*The six test farms are owned and operated by the North Carolina Department of Agriculture, and the employees on these farms are members of the Department of Agriculture staff.

Coastal Plain Test Farm—Willard

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D. P. Southerland	*Foreman*
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W. H. Stuart, Jr.	*Assistant Agronomist, U. S. Department of Agriculture*

Mountain Test Farm—Swannanoa

S. C. Clapp	*Assistant Director in Charge*
W. M. Whisenhunt	*Foreman*
H. B. Coulter	*Dairy Herdsman*
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Piedmont Test Farm—Statesville

J. W. Hendricks	*Assistant Director in Charge*
R. E. Stitt	*Assistant Agronomist, U. S. Department of Agriculture*

Tobacco Test Farm—Oxford

E. G. Moss	*Assistant Director in Charge*
James F. Bullock	*Assistant Tobacco Investigations, U. S. Department of Agriculture*
A. B. Dean	*Foreman*

Upper Coastal Plain Test Farm—Rocky Mount

R. E. Currin, Jr.	*Assistant Director in Charge*
Wm. Allsbrook	*Herdsman*
J. P. Young	*Assistant Tobacco Investigations, U. S. Department of Agriculture*

FIFTH-EIGHTH ANNUAL REPORT

of the

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

For the Year Ending

June 30, 1935

The following pages contain a brief account of the services and progress of agricultural research during the past fiscal year.

SERVICES RELATED TO THE RESEARCH PROGRAM

Emergencies arising from farm conditions have required the services of technical skill possessed by members of the research staff. These services have ranged from technical advice to the redirection of research programs to meet immediate problems. In the face of reduced State support the shifting to immediate problems has delayed progress on the regular program.

The need for agricultural adjustment has been evident throughout the State and region. All departments of the Station have cooperated in the research program initiated by the Federal Agricultural Adjustment Administration. The program has involved the cooperation of specialists in the various fields of research in the United States Department of Agriculture and those of the thirteen states located in the Cotton States Region. Though conditions and opinions differ somewhat within so large an agricultural region, the program was marked by the finest spirit of cooperative effort toward the solution of as common problem that has yet been exhibited on a regional basis.

Dr. G. W. Forster, Head of the Department of Agricultural Economics, has contributed thought and time to the supervision of the federal farm debt adjustment program. During the year the work of farm debt adjustment has been transferred to the Division of Resettlement.

Dr. C. Horace Hamilton, project leader in Rural Sociology, has acted as supervisor and coordinator of the federal emergency research program in this field. Special projects covering emergency human problems of the State have been conducted in cooperation with the Tennessee Valley Authority and the State Emergency Relief Administration.

SOILS OF FARMERS APPRAISED BY DEPARTMENT OF AGRONOMY

During the year thirteen hundred and sixty-four samples of soil have been carefully examined and appraised for five hundred and fifty-two farmers and gardeners of the State. The examinations have, in the main, consisted of establishing the type of soil, its physical condition and an estimation of its organic matter content. After this the pH value of the soil is determined, which is used as a guide in making lime recommendations. Having established the type of soil, the Department is enabled to make definite recommendations with reference to the plant nutrient requirements of the

soil in its present condition for the most economic production of crops wished to be grown. During the early spring months just before farmers are planning to buy their fertilizers, especially for tobacco and cotton, the Department workers are frequently taxed beyond capacity to keep up with the laboratory examinations and interpretations of soil samples sent in by farmers.

It is interesting to note in this connection that it has been found that a majority of the troubles farmers are having are due to too great alkalinity of the soil in the Piedmont region, and to minor plant nutrient deficiencies of soils in the Coastal Plain. Many of the "black-jack" soils of the Piedmont are naturaly about neutral or alkaline in reaction and when lime is used on them it unfits many of them frequently for the production of some crops without an application of remedial measures. In the Coastal Plain section of the State many of the soils are so deficient in minor plant food constituents, especially magnesia, that frequently crops grown on them cannot make a normal healthy growth, thereby leading to reduced yields under what might have been secured had these small deficiencies been supplied in available form. An increasing number of farmers each year hold off in buying their fertilizer for different crops until after they have had their soils examined and the Department advises them as to the best analyses and quantities to use for different crops to be grown on their different soils. No doubt the services of the workers of this Department have been worth thousands of dollars annually to North Carolina farmers in more intelligently making the largest expenditure for commercial fertilizers of any state in the Union.

TOBACCO FERTILIZER RECOMMENDATIONS FOR 1935

As in previous years, two workers of the Department of Agronomy are members of the Tobacco Research Committee and have aided in the formulation of fertilizer recommendations for the guidance of bright tobacco growers of the states of Virginia, North Carolina, South Carolina and Georgia. These recommendations for 1935 have been issued as Agronomy Information Circular No. 87 of this Department. The recommendations are freely sought by leading fertilizer manufacturers for their guidance in the fabrication of suitable fertilizer mixtures for use on bright tobacco throughout the belt and by growers themselves in buying suitable materials and compounding their own mixtures where home mixing is practiced and in guiding them in purchasing their requirements of mixed fertilizers for this crop if they do not do their own mixing.

The committee making these annual recommendations is made up of Agronomy workers from the states embraced in the bright tobacco belt and the Chief of the Federal Office of Tobacco and Plant Nutrition and some of his co-workers.

PHOSPHATE EXPERIMENTS IN COOPERATION WITH THE TENNESSEE VALLEY AUTHORITY

Phosphate Experiments.—A group of fertilizer experiments were started in the spring of 1934 in an effort to obtain information as to the relative efficiency of several high analysis phosphates in complete fertilizer mixtures used with and without a dolomitic limestone filler.

With this objective in mind, a uniform plan of fertilizer treatment was outlined and is being followed. In the Mountain and Piedmont areas 400 pounds per acre of a 4-10-4 mixture is used on all crops, and in the Coastal Plain area 400 pounds of a 4-8-4 mixture. In these mixtures the following high analysis phosphates as the carriers of phosphoric acid are being compared: Ammoniated monocalcium phosphate, ammoniated superphosphate, monocalcium phosphate, dicalcium phosphate and tricalcium phosphate. As sources of nitrogen in these experiments sulphate of ammonia, nitrate of soda and a mixture of equal quantities of each is used on separate plats. In addition, each experiment contains a check plat with no fertilizer, and one with a standard mixture with 16 percent superphosphate as the phosphate carrier; nitrogen from one-half sulphate of ammonia and one-fourth nitrate of soda and one-fourth from cottonseed meal. Muriate of potash is the sole source of potash throughout the whole system of experiments.

The experiments are being conducted in cooperation with farmers in North Carolina and are located principally in the TVA area of the State. All experiments are located on specified soil types and include some of the most important of these found in the various counties in which the experiments are being conducted.

The program includes ten experiments with corn, wheat and lespedeza in a rotation, the rotation starting with corn; four on permanent meadows with grasses for hay; five with corn and cotton in a rotation, the rotation starting with corn; and one on grasses for pasture.

Results with Corn.—Below is given a table showing the average yields of corn from fifteen experiments from the use of various phosphates in a complete fertilizer mixture. The percentage yields secured are based upon the yield of the standard mixture at 100.

SERIES A[1]

	Bushels per acre (Average)	Per cent yield based on standard mixture
Ammoniated monocalcium phosphate	44.3	111
Ammoniated superphosphate	40.7	102
Check—(No fertilizer)	29.0	73
Monocalcium phosphate	44.7	112
Dicalcium phosphate	43.3	108
Standard mixture (16% superphosphate)	40.0	100
Tricalcium phosphate	43.4	109

[1] No filler used in the fertilizer mixture.

SERIES B[2]

	Bushels per acre (Average)	Per cent yield based on standard mixture
Ammoniated monocalcium phosphate	42.5	104
Ammoniated superphosphate	41.4	101
Check—(No fertilizer)	31.2	76
Monocalcium phosphate	42.9	105
Dicalcium phosphate	42.6	104
Standard mixture (16% superphosphate)	40.9	100
Tricalcium phosphate	40.9	100

[2] Fertilizer mixture contained 500 lbs. of high grade dolomitic limestone per ton.

The above results show a decided increase from the use of commercial fertilizer in the production of corn. In series A, with no limestone filler in the mixture, the average yield for the fertilized plats is 42.7 bushels per acre, while on the check or unfertilized plats the average yield is only 29.0 bushels per acre, or an increase from fertilization of 13.7 bushels per acre. In series B, with 500 pounds of dolomitic limestone per ton of fertilizer mixture as a filler, the average yield for the fertilized plats is 41.9 bushels per acre, and on the check or unfertilized plats, the average yield is 31.2 bushels per acre, or an increase from fertilization of 10.7 bushels per acre.

It appears from the averages of one year that there is no increase in yield from the addition of dolomitic limestone as a filler in the mixture as the average yield on series B, with the dolomitic limestone filler, is 0.8 of a bushel less than on series A, where no filler was used.

Careful observations of each experiment were made and recorded several times during the growing season as to the growth and differences being shown by the plants on the variously treated plats. It must be remembered that the above results are not entirely consistent and no attempt is, therefore, being made to draw definite conclusions from this one season's results; however, taking the above yields together with the field observations, some very significant comparisons are evident and appeared so consistently on the entire 15 experiments that they appear to be worthy of note. They are as follows:

(1) Ammoniated monocalcium phosphate produced the best looking crop; (2) monocalcium phosphate and ammoniated superphosphate produced crops nearly as good; (3) dicalcium phosphate produced crops third best; and (4) tricalcium phosphate produced decidedly the poorest crops. With each of the above phosphates, where sulphate of ammonia was used as the source of nitrogen, the corn grew off much more vigorously and had a darker green color than was the case where nitrate of soda supplied the nitrogen in the fertilizer mixture. This was true to a very marked degree with tricalcium phosphate, slightly less so with dicalcium phosphate, and only slightly so with monocalcium phosphate. With ammoniated monocalcium phosphate and ammoniated superphosphate this difference was shown but to a comparatively small degree. The difference was greatest when the corn was knee to waist high and gradually became less, so that when the corn was entirely grown it was not evident in most cases and is not consistently reflected in the final yields. None of the phosphate carriers in a complete fertilizer mixture appeared to affect the stand of the crop.

These experiments are being continued for further results.

Results with Grasses for Hay.—The results of four experiments for the 1934 season show a fair response from the fertilization when applied on permanent meadows for hay grasses. The average yield for the fertilizer treatments on series A (with no filler in the mixture) was 4187 pounds of hay per acre, while that for the check plat, which received no fertilizer, is only 3185 pounds, or an increase for the fertilization of 1002 pounds per acre. The average yield for fertilizer treatments on series B (with 500 pounds of dolomitic limestone filler per ton) was 3850 pounds of hay per acre, while on the check plat with no fertilizer but 100 pounds of dolomitic limestone per acre, which is equivalent to 500 pounds per ton. In a 400

pound per acre application of fertilizer the yield was 2990 pounds of hay per acre, or an increase for the fertilization of 860 pounds.

It will be noted that the fertilization with no filler in the mixture gave a greater average yield than the mixtures containing the dolomitic limestone filler.

These experiments are being continued for further results.

Results with Grasses for Pasture.—One experiment is being conducted on pasture grass in Haywood County in the Mountain area of the State with the various phosphates used with and without dolomitic limestone filler in an effort to determine the relative efficiency of the various phosphates in a complete fertilizer mixture.

Clippings are made at intervals throughout the growing season on specified areas on the variously treated plats and both green and dry weights are obtained. No attempt will be made here to interpret one year's results. Observations for this one season, however, point out clearly that fertilization produces a decided increase in yield over no fertilization, and also that the growth of the grass in the early spring is greatly stimulated by such treatment.

New Triple Superphosphate Experiments.—Four new experiments were started in the spring of 1935 to compare the relative efficiency of triple superphosphate with 16 percent superphosphate. Also in these same experiments various fillers in the fertilizer mixture are being compared: viz., dolomitic limestone, ground calcium silicate slag, granular calcium silicate slag and gypsum.

Two of these experiments are located in the mountain section of the State in the TVA area. These are with corn, wheat and lespedeza grown in rotation. The two remaining ones were started in the spring of this year with cotton in the Piedmont and Coastal Plain sections of the State, using a cotton and corn rotation.

No results are available on these experiments at the present time as no crop has yet been harvested.

RESULTS WITH FLAX

A small experiment was conducted in 1935 with flax on Toxaway loam in Transylvania County to determine the yield and quality that might be secured when this crop was grown in the mountain area of this State, and also to determine the response of flax to fertilization. Careful observations on this experiment were made and recorded during the growing season and yields and other information are to be obtained after harvesting the crops.—C. B. Williams and S. A. Redfearn.

CHANGES IN STAFF

The resignation of Dr. J. G. Knapp, leader in marketing studies, and R. H. Rogers, project leader in Farm Management, is reported with regret since both of these men represented important phases of research in the State and have made valuable contributions to the program. Dr. Knapp has taken up research with the Cooperative Division, Farm Credit Administration, and Mr. Rogers has received permanent appointment with the Agricultural Adjustment Administration.

Miss Myra deHaven Woodruff, associate in home economics research, resigned July 15, 1934.

L. I. Case, associate in animal husbandry research in cooperation with the Bureau of Animal Industry, was transferred from the Experiment Station to the Agricultural Extension Service of the College, January 1, 1935.

D. H. McVey, assistant in agricultural economics, resigned April 1, 1935, to enter the service of Regional Director, Land Policy Section of the Agricultural Adjustment Administration.

PUBLICATIONS

The following is a classified list of publications of the Experiment Station during the year:

BULLETINS

Approved Practices for Alfalfa Growers. By P. H. Kime and H. B. Mann, N. C. Agricultural Experiment Station Bulletin No. 300 (Sept. 1934).

Experiments with Nitrogen Fertilizers on Cotton Soils. By J. J. Skinner, R. A. Lineberry and J. E. Adams, of Bureau of Chemistry and Soils, and C. B. Williams and H. B. Mann, of North Carolina Agricultural Experiment Station. U. S. D. A. Technical Bulletin No. 452 (Oct. 1934).

Serological Studies on Adult Carriers of Pullorum Disease. Technical Bulletin No. 48 (April, 1935).

Arsenical Injury on the Peach. Technical Bulletin No. 49 (May, 1935).

TECHNICAL ARTICLES

Report on Acid and Neutral Fertilizer Experiments with Cotton in 1934. J. J. Skinner, H. B. Mann and E. T. Batten. Proceedings of the 10th Annual Meeting of the Joint Committee on Fertilizer Application. (Nov., 1934).

Investigations on the Mechanical Application of Fertilizers for Cotton. H. B. Mann. Proceedings of the 10th Annual Meeting of the Joint Committee on Fertilizer Application, (Nov., 1934).

Fertilizer Reaction, Soil Amendments and Crop Production. H. B. Mann. Proceedings of the Southern Agricultural Workers Association, (Feb., 1935).

The Relation of Soil Treatment to the Nodulation of Peanuts. H. B. Mann. Accepted for publication in Soil Science, (Feb., 1935).

Significance of Minor Plant Foods. L. G. Willis. The Fertilizer Review, Vol. X, No. 2, March-April, 1935.

Effect of Nitrogen Fertilizers on Strawberry Production. H. B. Mann and R. A. Lineberry. Presented to the N. C. Academy of Science, May, 1935. Approved for publication in Journal Series.

The Value of Single Lock Samples as a Measure of Seed Purity in Cotton. J. H. Moore. Journal of the American Society of Agronomy, Vol. 26, No. 9, Sept., 1934, pp. 781-785.

A Revision of the Genus Magachile in the Nearctic Region. T. B. Mitchell. The Transactions of the American Entomological Society, Part 1, Vol. 59, pp. 295-361, January, 1934; Part 2, Vol. 61, pages 1-44, April, 1935.

Extraction of Gossypol from Cottonseed Meal: Effect of Moisture and Repeated Extraction with Ether by Different Procedure. J. O. Halverson and F. H. Smith, Ind. and Eng. Chem. *6*, p. 356, 1934 (Anal. Ed.).

AGRONOMY INFORMATION CIRCULARS

No. 87—*Tobacco Fertilizer Recommendations for 1935.* (September, 1934.)

No. 88—*Fertilizer Analyses for Different North Carolina Crops Including the Best Percentages of Water-Insoluble Nitrogen of Totals in Fertilizer Mixtures Recommended.* (September, 1934.)

No. 89—*Suitable Fertilizer Mixtures for Different Crops, Including the Functions of Chief Plant Nutrients.* H. B. Mann and W. H. Rankin, (September, 1934).

No. 90—*Precautions to Observe in Making Crop-Acreage Reductions and Adjustments in North Carolina.* C. B. Williams, (November, 1934).

No. 91—*Corn Varieties for North Carolina, 1925-1934.* P. H. Kime, (February, 1935).

No. 92—*Results of Cotton Variety Experiments, 1930-1934.* P. H. Kime, (February, 1935).

No. 93—*Some Facts About Legumes as Soil Improvers.* C. B. Williams (March, 1935).

No. 94—*North Carolina Soils Evaluated for Crop Growth.* C. B. Williams and J. F. Lutz, (June, 1935).

PROGRESS OF CURRENT RESEARCH

In presenting the progress of active research the projects have been classified in three major groups according to their objectives for the purpose of associating related projects. The three groups are designated, I Soil Research, II Farm Enterprises, and III Human Factors in Agriculture.

I. SOIL RESEARCH

Soil Survey of Counties of the State.—This work is being conducted in cooperation with the Federal Bureau of Chemistry and Soils, and beginning with May of this year the Tennessee Valley Authority joined cooperatively with the two institutions in starting work in unsurveyed counties and in counties needing resurveying of the State embraced in the TVA area. At the present time field work is being carried on in Clay and Madison counties by six trained workers. The scale on which the work is now being conducted is 2.64 inches to the mile, which is on a much larger scale than has been used heretofore in this State and throughout the United States. The soil survey is a recognized study and record of the soil resources of each county. Through it the soils are identified and classified into separate types based on their inherent physical and chemical characteristics, such as natural features as stoniness, slope, geographical position and drainage, together with the extent of erosion, degree of plant food depletion, current productive capacity, potentialities, and other characteristics. The several soil types in each county are fully described in reports printed by the U. S. Department of Agriculture, accompanied by maps on which the location and extent of the types occurring are delineated. These reports have been of invaluable service to the Department in logically locating its experiments and in interpreting them to farmers located in the same and other counties of the State. Practically no work is undertaken or interpretation made by the Department except with reference to soil type.—C. B. Williams, W. A. Davis, and E. F. Goldston.

Technical Soil Research Problems.—In addition to the technical research work done during the past year, efforts have been made to test the practicality of some of the interpretations that are made as the work is in progress, as well as upon completion. Since the research projects have been developed largely for the solution of local problems involving soil-plant interrelations, there are numerous fields where informal tests can be located. In addition, many letters are received annually describing apparently abnormal conditions, to some of which the hypotheses developed in research work can be adapted. Frequently it has been found advantageous to have the soils showing these conditions sent to the laboratory where simple pot culture experiments are used both for verification of the hypotheses and practical solution of the field problem.

The plan has been of considerable value from both angles and has resulted in putting research results into use even before the projects have been completed. In the course of the work many new problems are exposed, some of which demand prompt investigation.—L. G. Willis and J. R. Piland.

Oxidation-Reduction Studies.—Studies of the oxidation-reduction equi-

librium of soils were started in an attempt to determine the causes of the relative unproductiveness of extensive areas of reclaimed swamp lands. These have progressed to the point where it seems certain that some decomposition product of the organic matter maintains an injurious concentration of soluble iron in these soils.

Apparently the direct determination of oxidation-reduction potentials is of little value in diagnosing this condition but there is a possibility that a modification of the original research plan will give more satisfactory data. Soil color, which appears to be associated with the degree of decomposition of the organic matter, gives the best indication of the degree of unproductiveness. The brown soils are the most troublesome, while the black soils are the most productive under natural conditions.—L. G. Willis and J. R. Piland.

The Use of Copper Sulphate on Peat Soils.—From the laboratory data it appeared that any agent having the effect of activating oxidation should remedy the defect of these soils, and copper sulphate gave the most promising indications of providing this effect. Tests of copper sulphate in the greenhouse and in fields have been distinctly successful in increasing crop growth.

According to this interpretation of the laboratory results, copper sulphate would serve as a soil amendment and a single moderate application should be effective for several years. Fifty pounds of copper sulphate seem to be about the most desirable rate of application for soils of high organic matter content. Field tests show that this amount has been effective for six years. It has also been found necessary to apply the copper sulphate well in advance of planting. It should be broadcasted and disced into the soil. In the typical cases the best results with copper will be obtained on soils that are moderately limed.

Manganese sulphate has an effect similar to that of copper sulphate but it is less efficient in controlling the unfavorable soil condition.

The beneficial effect of copper is most pronounced with those crops that on ordinary soils are the least tolerant of soil acidity.

In fertilizer experiments on these peat soils it has been found that fertilization with phosphates is injurious to soybeans, while very heavy fertilization with potash is beneficial. The use of copper sulphate corrects symptoms of injury similar to those associated with the use of sulphates, and also those that have been ascribed to a potash deficiency. It is desirable that all fertilizer and liming experiments on these soils be repeated after an application of copper sulphate has been made, and also that more exact information be obtained regarding the most efficient rates and frequencies of application of copper sulphate.

It is also probable that a wider range of crops can be grown on these soils after applications of copper sulphate have been made, and that winter hardiness of cereals and drouth-resistance of pastures may be improved.—L. G. Willis and J. R. Piland.

Copper Sulphate as a Remedy for an Excess of Soluble Manganese.—The work with copper sulphate seems to offer a possibility of the solution of another problem that has engaged the attention of the experiment station staff for several years. Farmers have reported an abnormality known locally

as "laying down" of cotton from soils in the basins of the Tar and Roanoke rivers. A simple pot culture test with this soil in the greenhouse showed that cotton plants were absorbing abnormal quantities of manganese.

A survey of conditions in the field gave evidence that the severity of the trouble could be correlated with the manganese content of the cotton stalks, but not with the pH of the soil. It was assumed from limited experimental data that manganese existed in the soil in the bivalent form as an exchangeable base and that copper sulphate might serve to effect the oxidation of the manganese to an insoluble form.

Pot culture tests in the greenhouse gave strikingly favorable results with copper. Thorough drying of the soil in air was even more effective. Preliminary tests in the field where the copper was applied in the fertilizer did not give conclusive results.

Since there are in the State approximately 100,000 acres of the soil type on which this trouble occurs it will be desirable to carry this research work further as soon as time is available.—L. G. Willis and J. R. Piland.

Copper Sulphate as a Cause of Iron Deficiency.—If copper sulphate can reduce excessive concentrations of iron in the soil it may also cause symptoms of an iron deficiency in plants grown on soils low in iron. It has been found that this does occur in corn grown in pots in a peat soil and also in cotton grown in solution cultures. Whether or not a similar deficiency of iron will develop on sandy soils where the residues of copper sprays accumulate is a problem that should be given immediate attention.—L. G. Willis and J. R. Piland.

Properties of Soil Organic Matter.—Some characteristic properties of the organic matter of the peat soils were exhibited by the results of the oxidation-reduction potential studies. It is not improbable that a continuation of this work will result in a better understanding of the beneficial functions of organic matter in all soils.

From a practical standpoint the work on manganese deficiency is completed. The fact that it occurs in North Carolina only on soils having greater than normal organic matter content, however, offers interesting possibilities for further technical investigations. In this case also the work on oxidation-reduction potentials suggests a mechanism by which manganese may be made insoluble. If the hypothesis that has been developed is valid, the problem should not be difficult to solve.—L. G. Willis and J. R. Piland.

Fertilizers as the Cause of Magnesium Deficiency.—Magnesium deficiency has become serious on extensive areas of the sandy soils of the State. It has been found that calcitic lime makes the magnesium of the soil unavailable to plants and that calcium sulphate, which commonly makes up as much as 25 percent of ordinary fertilizers greatly increases the losses of magnesium by leaching. The opinion that magnesium deficiency is largely the result of fertilization according to present methods is supported both by observation and experiment.

The common grades of fertilizers have therefore been making the magnesium of the soil available to plants. This must mean that a part of the crop response from these fertilizers has not come directly from the fertilizer. No doubt the ratios of nitrogen, phosphoric acid and potash now considered

most satisfactory will need to be revised when it becomes necessary to add magnesium and other elements to fertilizers.

Experimental work on this phase of soil fertility should be undertaken immediately so that means may be found for preventing further unnecessary depletion of the essential elements of the soil. The experimental evidence supports an opinion that fertilizers of higher concentration than those now in use offer the best prospect for the conservation of the natural fertility of the soil.

For soils that must be kept within a narrow range of soil acidity it appears that the use of dolomitic limestone in excess of the amounts needed to correct the potential acidity of the fertilizer may result in an accumulation of calcium. This will raise the pH of the soil and decrease the availability of the magnesium that is not removed by leaching.—L. G. Willis and J. R. Piland.

Neutralizing Effect of Organic Nitrogen.—It is commonly understood that the peculiar value of organic forms of nitrogen in fertilizers depends on the fact that these become available slowly throughout the growing season and are not subject to leaching. Recent laboratory studies show that in warm soils these materials decomposed very rapidly into ammonia. This is readily available to plants and no less subject to leaching than other compounds of ammonia. The results indicate that a part of the value of the organic forms of nitrogen may be due to neutralization of soil acidity by the ammonia formed by decomposition.—L. G. Willis and J. R. Piland.

Relation Between Liming and Chlorine Injury to Tobacco.—Further studies of the effect of lime in decreasing chlorine injury to tobacco and the chlorine content of the leaves has confirmed prior results. It is not improbable that additional research will show that the tolerance to chlorides of plants other than tobacco is inversely related to the pH of the soil. The question of the relation between the acidity of tobacco fertilizers and the most desirable chlorine content remains unsolved.—L. G. Willis and J. R. Piland.

Boron Deficiency.—On one farm where many of the interpretations of research results have been tested, a serious defect of romaine plants has been observed after all the soil deficiencies known to exist in the State had been corrected. Preliminary experiments indicate the possibility of an additional deficiency of boron. The symptoms have been observed in a less pronounced degree on other fields and a rough correlation has been noted between these and the amount of muriate of potash used in the fertilizer. If further investigation substantiates this observation it will be advisable to determine whether or not any of the effects heretofore considered indicative of potash deficiency are in reality due to a need for boron.—L. G. Willis and J. R. Piland.

Soil Erosion.—The cooperative soil erosion research program conducted at Statesville, N. C., by the Bureau of Agricultural Engineering, the Bureau of Chemistry and Soils, and this Station has been continued. A complete report of this program is contained in the 1934 report of the Station.

II. FARM ENTERPRISES

Regional Agricultural Adjustment in North Carolina.—This was an emergency project, the purpose of which was to determine what changes in the 1929 acreage and production of crops and the number and production of each class of livestock should be made in each type of farming area of the State in order that fertility might be maintained, erosion controlled, and an efficient sound farm management program be promoted.

The first task in the execution of this project was to divide the State into two types of farming areas. The criteria for this division were the crops grown, the character of the soil, and climatical conditions. As a result of this study of these factors, together with the judgment of the special committee appointed for this purpose from the departments of Agronomy, Animal Husbandry, Horticulture, Poultry, Dairying and Agricultural Economics, the State was divided into eight principal areas and three subareas.

The basic maps for this study were prepared by the Department of Agronomy. The statistical work which included the compilation of data on yields, livestock production, material requirements for crop production, feeds, prices and expense items was supervised by the Department of Agricultural Economics.

The statistical and physiological data permitted the analysis of each agricultural area and revealed the strength and weakness of the existing types of farming. In the main, the analysis of the areas revealed the absence of a definite crop rotation, inadequate supply of livestock, inadequate production of crops for soil improvement, and a high percentage of the cultivated land in row crops.

Following the analysis of each area, the committee suggested changes in the systems of farming which would remove these defects or lessen their destructive effects. When this work was completed a mimeographed publication, setting forth the statistical data required, analysis of each area and recommendations as to the most desirable type of farm, was published.—G. W. Forster, R. E. L. Greene (Agricultural Economists); C. B. Williams and J. F. Lutz (Agronomy); Earl H. Hostetler (Animal Husbandry).

A Study of Dairy Cattle as a Supplementary Enterprise to Cotton Farming in the Piedmont Section of North Carolina.—The object of this study is to obtain information regarding dairying as a supplement to cotton production. Thirty-two acres of land on the Central Experiment Station farm, a section of the cow barn, a separate silo, and eight cows are being used in this project which was started in 1928. The study is being jointly conducted by the Dairy Husbandry, Agronomy and Agricultural Economics departments. The latter department posts the monthly labor and cost data and at the close of each year prepares a summary statement showing the cost of each crop produced, and also the cost of maintaining the herd. The department also renders assistance to the other cooperating departments in developing ways and means of reducing costs, and to conduct the experiment in such a way as to reflect actual farm operations. A summary of the operations has been prepared for each year from 1929 to 1934, inclusive. No crops were produced in 1933 because the land was divided in a new field arrangement and this was completed too late for any crops to be grown.

This experiment has not been running long enough to draw any definite conclusions from the results obtained to the present time. The dairy herd has shown considerable improvement and the cost of producing milk dropped from 28.11 cents per gallon in 1930 to 11.01 cents in 1933. The price rose to 14.55 in 1934, however. The yield of cotton in rotation has tended to show some increase over that not in rotation. In 1929, when the experiment was first started, the yield on the cotton field not in rotation was higher than the yield on the field in rotation. Since that time, however, with the exception of 1931, the yield has been higher on the field in rotation than it has on the field not in rotation.—R. E. L. Greene and C. D. Grinnells.

A Study of Peach Orchard Management.—The objectives of this study are: (1) To study peach orchard management over a period of years and to note the reaction of growers to price changes and conditions of crops; (2) To determine the amount of capital necessary to successfully conduct such a business where the "turnover" is slow and the risks so evident; and, (3) To observe the selection and relative importance of other enterprises and the results of enterprise combinations of peach farms.

The survey method of obtaining data has been used in conducting this study. The first survey was made in 1928 when 39 records were taken; 45 records were taken in 1929; 34 in 1932, and 48 in 1934.

These farms showed a high return on their investment in 1928. During each of the years 1929 to 1932, however, the farms surveyed showed an average loss of 15.34, 11.59, and 19.54 percent on their investment, respectively. In 1934, along with the increase in prices of other agricultural commodities, there was also an increase in the price of peaches. The farms surveyed showed an average return of .51 percent on their investment that year.—R. E. L. Greene.

The Organization and Management of Farms Operated by Cropper Labor.—This project was originally started in 1928 with a farm survey of 112 farms located in Wayne, Pitt, Lenoir, Halifax and Edgecombe counties. In 1930 a survey was made of 60 of the original farms, and in 1934 a careful farm record was obtained from 40 of the original farms. In addition to the farm management schedules, a supplementary schedule was obtained from each landlord and from each cropper. A part of the information collected in 1928 was published in Experiment Station Bulletin No. 271, entitled, "Credit Problems of North Carolina Cropper Farmers." A statistical summary of the 1930 study was published in the annual report of the Station for that year.

During the summer of 1935 a farm management survey was made in which records were secured from as many of the original owners as possible. In addition to this, supplementary schedules for both owners and croppers were taken. In this survey 56 survey records, 73 owner records, and 194 cropper records were obtained. Farm record books were kept by 22 owners during the year 1934. The records taken in 1935 are similar to those obtained in 1928.

During 1935-36 the data collected during the period of the project will be analyzed and prepared for publication. Probably a bulletin will be prepared on the recent credit aspects of the farm business, and one on the organization and management of the farms. The information will reveal

the changes which have taken place not only in the organization and management of farms under the Adjustment Program, but will tend to shed some light on the changes in the status of the cropper.—G. W. Forster and R. E. L. Greene.

A Study of Methods and Practices Employed in the Production of Cotton, Tobacco and Other Cash Crops.—The objectives of this study are to obtain information on the organization and management of selected farms and to secure details regarding the methods and practices followed in growing the particular crops studied. From data thus obtained, improved practices may be suggested whereby production costs can be lowered and incomes improved on similar farms within the area of which these studies are typical.

Results have been tabulated from a study of 36 farms producing cotton in 1930; 26 farms growing cotton, and 8 farms growing tobacco in 1931; 29 farms growing cotton, and 9 growing tobacco in 1932; 28 farms growing cotton, and 16 growing tobacco in 1933; and 22 farms growing cotton, 19 farms growing tobacco and 38 farms growing commercial Irish potatoes in 1934. In addition to these, data were obtained on 59 farms in 1934 by means of the survey method.

The cost of producing a pound of lint cotton declined from 9.86 in 1930 to 4.55 cents in 1933, but the cost advanced to 6.88 cents in 1934. This increase in 1934 was due in part to a general increase in the price of labor, and also in materials such as fertilizer. The cost of producing a pound of tobacco declined from 1931 to 1933, but not as much as cotton. In 1931 the cost was 9.99 cents per pound, and in 1933, 7.61 cents per pound. The 1934 cost showed an increase over the other years, being 10.25 cents per pound.

Field work has been completed and it is planned that a preliminary report will be issued summarizing the data collected.—R. E. L. Greene.

ROTATIONS

At Coastal Plain Branch Station (Dunbar fine sandy Loam)

Fertilizer and lime requirements for crops grown in a three-year rotation of corn, oats-and-vetch, soybeans (turned under), and soybeans for seed (Field A).—The soybean crop grown in this experiment in 1934 was harvested for seed. The yields from the crop add to the findings of previous years that the use of a complete fertilizer for the crops in this rotation is essential. The use of lime once in the rotation has increased the yields of the crops grown. However, applications of lime have made conditions more favorable for the development of corn root rot. The disease has only been held in check on those plats which have received heavy applications of potash.

On the limed series of plats a manganese deficiency chlorosis is prevalent on the soybeans, and continues to become more severe and injurious to the crops as the experiment progresses.—C. B. Williams, W. H. Rankin, and Chas. Dearing.

Fertilizer and lime requirements of crops grown in a three-year rotation of corn, oats-and-vetch, and soybeans (Field E).—The object of this experiment is to determine whether the fertilizer requirements of the crops could be supplied by applying the same amount of nutrients that are re-

moved by the crops when harvested. The results secured thus far show that the fertilizer requirements cannot be met in this way. Crops take up far larger amounts of both nitrogen and potash than it is economical to apply.

Applications of lime once in the rotation, in addition to this method of fertilization, have not been profitable and have served to make the manganese chlorosis of soybeans more severe.—C. B. Williams, W. H. Rankin and Chas. Dearing.

At Upper Coastal Plain Branch Station

A Study of the utilization of crops grown in rotation with cotton by two different methods.—This cooperative experiment with the Animal Husbandry Department was inaugurated in 1927 to compare crop yields, financial returns and fertility of the soil under two methods of crop utilization. There are three one-acre plats grown to a three-year rotation. Plat one is fertilized normally and all cover crops are turned under for soil improvement. Plat two is fertilized the same as No. 1, but all crops are "hogged off" except cotton. Plat 3 is "hogged off" the same as No. 2, but in fertilizing credit is taken for 80 percent of the fertilizing value of supplementary feeds given hogs. As indicated by the yields of seed cotton in 1934 (plat 1—874 pounds; plat 2—1209 pounds; plat 3—910 pounds per acre), the fertility of the soil in plat 2 is being maintained at a higher level than either No. 1 or No. 3, which are producing about the same yields per acre.—H. B. Mann, Earl H. Hostetler, and R. E. Currin, Jr.

At Blackland Branch Station (Muck)

Rock Phosphate, superphosphate and duplex basic slag compared as sources of phosphoric acid for corn; oats followed by soybeans for soil improvement; and Irish potatoes followed by soybeans for soil improvement grown in a three-year rotation (Field A).—The results from this experiment show that all the crops in the rotation respond more to potash than to either nitrogen or phosphoric acid. The crops show little or no response to applications of phosphoric acid from superphosphate, basic slag or finely ground rock phosphate. The plats that were treated with phosphate have produced yields less than the untreated plats.—C. B. Williams, W. H. Rankin and J. L. Rea, Jr.

A study of different cultural methods in relation to stand and yield of corn and soybeans when grown in a two-year rotation on peat soil (Field K).—The yield records over a period of nine years have shown that larger yields of both soybeans and corn have been secured where the soil has been disced four inches deep than where the soil has been plowed eight inches deep. Rolling the soil before planting has had no effect in increasing the yield.

The use of the ridge method of cultivation of crops grown on this soil gives no better results than does the use of level cultivation under average seasonal conditions. Larger yields are obtained only by the use of the ridge method in very wet seasons.—C. B. Williams, W. H. Rankin and J. L. Rea, Jr.

Fertilizer and lime requirements for corn and soybeans grown in rotation, the soybeans being produced for seed in one series and utilized for

hay in a Second series on peat soil (Field W).—Soybeans were grown on this experiment in 1934 and the results become more outstanding each year. The largest yields have been produced on plats that received high percentages of potash, very low percentages of phosphoric acid and low percentages of nitrogen.

It is interesting to note that in this experiment where 400 pounds of a 0-4-5 (plat No. 12) was used on corn that the yield of corn in 1933 was 47.7 bushels per acre where the soybeans had been picked and the vines turned under, and where the previous crop of soybeans was cut and removed for hay the yield was 6.6 bushels less per acre.

Where the phosphoric acid in the mixture was increased from 4 to 8 percent (plat No. 11) the yield of corn was only 38.9 bushels following soybeans picked, and 34.4 bushels following the soybeans cut for hay, a difference of 4.5 bushels per acre.

Where 20 pounds of potash from manure salt alone (plat No. 7) was applied the yield of corn following soybeans picked was 42.8 bushels, and following soybeans cut for hay 33.9 bushels, a difference of 8.9 bushels per acre.

Unfertilized, the corn in 1933 yielded only 21.3 bushels, which was 1.3 bushels more per acre where the soybeans had been picked than where they were cut for hay (20.0 bushels).—C. B. Williams, W. H. Rankin and J. L. Rea, Jr.

At Piedmont Branch Station (Cecil clay Loam)

Fertilizer and lime requirements for cotton, corn, wheat and red clover when grown in rotation on this type of soil (Fields A and B).—The main objectives of this experiment are—(1) To determine the nitrogen, phosphoric acid and potash deficiencies of this soil type; (2) the proper proportions of nitrogen, phosphoric acid and potash that should be used for leading field crops; (3) the best quantity of fertilizer to use per acre; and (4) to study the symptoms of any nutrient deficiencies that may develop.

It has been found that when applied singly phosphoric acid is the most important nutrient to be supplied for production of cotton, corn, wheat and red clover, with nitrogen ranking second in importance, and potash the least important, so far as yield is concerned. However, for the control of potash deficiency ("rust") of cotton and frenching of corn, potash is of primary importance to be added.

From observation on the 1933 cotton crop and 1934 corn crop on Field A, and the 1934 cotton crop on Field B, it is evident that potash deficiency of cotton is most severe in its damage where higher percentages of superphosphate are applied in the fertilizer mixture or where it is used in large amounts. Results secured show that an application of one ton of limestone once in the rotation accentuates the potash deficiency symptoms of cotton, lowers the quality of the fiber and seed of the cotton.

For the production of red clover on this soil lime is not only essential to be added but liberal quantities of available phosphoric acid and potash.—(C. B. Williams and W. H. Rankin.)

Studies of the efficiency of superphosphate and rock phosphate as sources of phosphoric acid on Cecil clay loam soil when seeded to a rotation of corn, wheat and red clover.—When equal amounts of phosphoric acid are applied from superphosphate and rock phosphate, the superphos-

phate produces larger yields than rock phosphate. With the increasing quantities of rock phosphate applied the severity of potash deficiency symptoms and damage has been found to increase. This observation is evident on both the limed and unlimed series of plats, it being as in other cases always more pronounced on limed series.—(C. B. Williams and W. H. Rankin.)

A study of the yield and quality of crops when wheat and corn each are grown continuously on the land; when grown in a two-year rotation of the two; and when grown in a three-year rotation of the two with red clover on Cecil clay loam.—The most outstanding difference is between continuous corn without lime and a three-year rotation of corn, wheat and red clover with lime applied once in the rotation. The average yield of corn per acre where corn has been grown continuously with a complete fertilizer is 19.3 bushels, while the average yield of corn per acre in a three-year rotation of corn, wheat and red clover is 37.3 bushels.

At Mountain Station (Toxaway loam and Porters loam)

Fertilizer requirements for corn, wheat and soybeans when grown in a three-year rotation on Toxaway loam soil (Field A).—From this study it has been shown that larger and more economical yields of soybean hay have been produced from those with a normal percentage of phosphoric acid in the mixture. This year's yields further substantiate the previous findings.—(C. B. Williams and W. H. Rankin.)

Fertilizer and lime requirements for Irish potatoes, wheat and soybeans when grown in rotation on a Toxaway loam type of soil (Field B).—The yields of the crops grown during the twenty-year period that this experiment has been in progress have shown that a complete fertilizer has produced the most economical yields of each of the three crops in the rotation. For wheat and soybeans a complete fertilizer with an application of one ton of limestone once in the rotation produced the best yields; however, for the potatoes the use of limestone made the conditions favorable for the development of abundance of scab on the potato tubers, which resulted in a low yield of very inferior potatoes.

With the wheat crop of 1934, this experiment was completed and discontinued.—(C. B. Williams and W. H. Rankin.)

Rock phosphate, superphosphate, soft phosphate and basic slag compared as sources of phosphoric acid on Toxaway loam soil when corn, wheat and soybeans are grown in rotation (Field G-2).—This experiment is composed of three series of plats, the first series with lime once in the rotation, the second series without lime, and the third series with the nitrogen derived from stable manure.

The yield data shows that the limed series has produced larger yields than the series that did not receive lime and that superphosphate is the most efficient source of phosphoric acid used in these trials.—(C. B. Williams and W. H. Rankin.)

Rock phosphate and superphosphate compared as sources of phosphate acid for corn, oats, wheat-and-soybeans on Toxaway loam (Field G).—The records from this experiment add to the findings of previous years that superphosphate is a superior carrier of phosphoric acid when measured in terms of crop yields produced in this crop rotation.

Comparison of rock phosphate and superphosphate for corn when crimson clover is grown as the inter cover crops in a cropping system of continuous corn on Toxaway loam (Field G-1).—Results have shown that superphosphate has produced larger yields of corn per acre than has the same amount of phosphoric acid derived from finely ground phosphate rock.

Another finding in connection with this experiment is that the yield of corn per acre has been maintained and even increased on this soil by continuous cropping, if a winter cover crop of crimson clover is grown each year and turned under in advance of planting the corn.—(C. B. Williams and W. H. Rankin.)

A study of different fertilizer treatments and methods of utilizing the legume crops after grown in a three-year rotation of corn, soybeans, wheat and lespedeza on Porters loam soil (Field R).—Since this experiment has only been in progress one year no indications are given at this time as to what may be expected.

TOBACCO INVESTIGATION

In these investigations which are being conducted cooperatively between the State Department of Agriculture and the Federal Bureau of Plant Industry, the following have been some of the findings during the year at the Tobacco and Upper Coastal Plain Branch Stations, the places at which the tobacco work is conducted:

At Tobacco Branch Station, Oxford

The agronomy research work at this station has consisted of a study of fertilization and variety problems.

Considering it from the fertilizer standpoint, fertilizer treatment tests have been made using the principal plant nutrients and some studies have been made with reference to some of the elements which until recently have not been considered of serious importance. In mapping out a program covering the various elements it has been difficult to find sufficient land on the station farm to continue these field tests in a way and over a period sufficiently long to get very definite results. However, there have been plats of the station farm on which tobacco was planted that showed definite deficiencies in calcium, magnesium and potassium, and some evidence of an excess of sulphur and nitrogen. Up to the present time, neither boron nor any of the other rare elements have been studied in any of the field tests.

In addition to the numerous tests with plant nutrients, more attention during the year has been paid to cropping systems or rotations than heretofore. Studies have been made of the natural weed growth on the station farm and in the vicinity of the farm as it related to the production of high quality flue-cured tobacco. The complications, however, that arise when the natural weed growth is permitted is that a number of weeds that are common to this area are very susceptible to Granville wilt. This being true, it makes it more difficult to work out a cropping system which is adapted to the production of tobacco and at the same time control this particular disease.—(E. G. Moss.)

Variety Tests.—A large number of varieties of tobacco have been tested under field conditions during the past few years. Of this number, which will probably total in the neighborhood of 200 or more varieties and strains, the station has eliminated all except five varieties, viz: White Stem Oronoco,

Cash, Jamaica, Bonanza, and Virginia Bright Leaf. There are two or three other varieties which show considerable promise, and at least one or two of these are especially fitted for production in the areas infested with black root rot (Thielavia). The more recent studies have been devoted almost exclusively to individual plant selections of these five best varieties with a considerable amount of attention being paid to crossing some of these varieties on other types. Plant breeders will easily understand the difficulties which arise whenever it is undertaken to cross one type of tobacco on another and maintain the original quality which has made the various types of tobacco popular in their respective fields. For that reason it is not anticipated that quick results from this line of work will be obtained, although it offers an unlimited field for research. On the other hand, progress has been made in selecting individual plants from these varieties which are best adapted to this area. Seed have been saved from the best selections and distributed through seedsmen in the State who are growing and selling certified seed. Each year increasing numbers of growers buy their tobacco seed from parties who grow and sell certified seed. In order for these growers to have their seed certified, they must get new seed from the Station at least every two years.—(E. G. Moss.)

At Upper Coastal Plain Branch Station, near Rocky Mount

At this farm four main experiments have been conducted with the results indicated below.

Split Application of Fertilizer Mixture.—In this experiment, using as a basal application of 1000 pounds per acre of a 3-8-5 mixture, the basal mixture is split on some plats, a part being applied underneath the plants at planting time and part reserved and applied as a top-dressing. On other plats additional nitrogen is applied as a top-dressing to supplement the basal mixture applied at transplanting time. On other plats both nitrogen and potash are used as top dresser. Nitrate of soda and sulphate of ammonia are being compared as top dressers. So far the top dressing has paid only under these conditions, that is, where the land is unusually poor and sandy or where we have had very heavy rains just after planting tobacco.—(E. G. Moss.)

Experiment to determine the effects of so-called minor plant foods on growth and quality of tobacco.—Sulphur, lime, chlorine and magnesia have been tried out in different amounts from different sources. In this the third year of the experiment, results have not shown the larger amounts of sulphur and chlorine of the original experiment to be injurious to tobacco grown on the soils of this farm. The use of 20 to 40 pounds of magnesia has shown to be of some benefit. Extra quantities of lime per acre have not seemed to prove of any value except where extra large applications of chlorine had been made to some supplemental plats added to the experiment.—(E. G. Moss.)

Sources of Potash.—In this experiment results thus far secured have shown that used as single sources of potash in a complete fertilizer mixture analyzing 3-8-6, American muriate of potash and German muriate of potash have given best results. However, the very best results have been obtained when the source of potash is equally derived from muriate of potash and sulphate of potash-magnesia.—(E. G. Moss.)

Tests of varieties and strains of bright tobacco.—In this experiment Virginia Bright Leaf, Gold Dollar (Coker), Hickory Prior (Oxford) and Bonanza (Oxford) have been found to be the leading varieties.—(E. G. Moss.)

Tobacco Mosaic.—In fields which bear a crop of tobacco diseased with mosaic, leaching from decaying diseased roots, stems and leaves furnish abundant opportunity for the soil to become contaminated with the virus of this disease. A study is under way to determine how long the mosaic virus will remain active and capable of producing disease in soil. As has been previously announced, when soil containing virus particles free of tobacco tissue becomes approximately air dry, the virus is inactivated and does not become active and capable of producing disease again when water is added to the soil.

Tests were made by a method of direct comparison to determine the relative inactivating power of natural soils belonging to the same series (Norfolk and Granville) but differing in textural grade. In general, the soils containing greater proportions of fine material as clay and colloid inactivated more virus upon drying than soils containing proportionately more coarse material. From the data at hand, which must be considered inconclusive at present, there appears to be a weak correlation between content of fine material and the power of a soil to inactivate mosaic virus upon drying.

A tobacco soil typical of the coastal plain tobacco area was separated by sedimentation into its constituent coarse and fine fractions. These soil separates were tested for relative ability to inactivate tobacco mosaic virus. The results indicate that the finer fractions have greater inactivating power than the coarser separates. The sand fraction exhibited lower and the clay and colloid fraction higher inactivating power than the original soil. The silt fraction was approximately equal to the original soil in ability to inactivate mosaic virus.

Equal quantities of a suspension of tobacco mosaic virus were added to different lots of a Norfolk sandy loam soil in such a way as to adjust the soil to different water contents ranging from 4% to 70% of its saturation capacity. These soil lots were stored at room temperature in diffused light in closed glass containers to prevent loss of moisture. The mosaic virus became inactive first at 4% soil moisture and somewhat later at 50 and 70%, but at 10 and 35% a large part of the virus was still viable after 1½ years. When the virus was stored in the same soils in the form of pulverized infected leaf material, the virus became inactive first in the cultures having high moisture content and deteriorated least in the soil having lowest moisture content. In soils containing more than very small percentages of water, i.e., not air dry, inactivation of the mosaic virus appears to be correlated with biologic activity.

Crosses are being made between the resistant Ambalema tobacco and certain varieties now being grown in North Carolina. It is hoped to obtain a selection suitable for culture in North Carolina and highly resistant to systematic infection by the common mosaic virus.—S. G. Lehman.

Studies on the control of Granville Wilt.—Previous studies on the treatment of soil infected with *Bacterium solanacearum* with sulphur at the rate of 400 and 600 pounds to the acre gave control of the Granville Wilt. However, sulphur caused serious thickening and blistering of the leaves in

such a manner that the quality was impaired. It was apparent that an increase in the acid condition of the soil as a result of sulphur oxidation was responsible for the impairment in quality. During the past year sulphur was applied one month before transplanting. At the time of transplanting the plots treated with sulphur were treated with lime to correct the acidity. This dual treatment gave partial control of the disease, but the leaf qualities were still impaired. The plants also remained stunted throughout the season, despite the fact that the soil reaction was made favorable for growth after the lime was applied. This would indicate that other and unknown toxic substances are formed from the sulphur.

Commercial ferrous sulphate broadcast at the rates of 1000 and 2000 pounds to the acre greatly reduced infection, indicating the advisability of an intensive study of the effects of this chemical on the organism. In laboratory studies it has already been shown to have controlling values on a pure culture of the bacterium that causes wilt. The large amounts of commercial ferrous sulphate used in these tests caused mild stunting of the plants which must be overcome before this chemical can be considered for practical application.

Commercial cyanamide at the rates of 500 and 1000 pounds to the acre also delayed infection sufficiently to warrant further studies of its effect on the organism. This material caused serious necrotic injury on the leaf. This effect may prevent the use of cyanamide even if it is found to completely control the organism. This material changed the soil reaction from pH 4.6 to pH 8.0 soon after it was applied, but during the season the reaction gradually reverted towards the original reaction.

Copper sulphate broadcast at the rates of 500 and 1000 pounds to the acre also reduced infection; however, these amounts were so toxic to the root system that sufficient plants were not available to determine its effect on the organism. Even crab grass failed to grow on the treated plots.

Since there has been considerable variation in losses on soils treated with lime, additional applications up to 3000 pounds per acre were studied. It was shown that liming soils having a pH of 4.6 to 4.8 changed the reaction to pH 7.5 and actually resulted in a stimulation of early growth. However, plants on the limed plots showed earlier symptoms of disease and died more quickly than those on untreated plots.

Zinc sulphate, manganese sulphate, organic mercury, formaldehyde and other materials at various amounts up to toxic strengths were used but they did not indicate any control values.—R. F. Poole.

A study of the effects of chemical treatment of the soil on the control of Phytophthora Nicotianae, causal fungus of Black Shank of tobacco.—The Cecil and related soil types, on which tobacco is grown in the Piedmont areas of this State, favorably support the causative fungus of the black shank disease. The fact that the fungus was reported in Kentucky and Tennessee as well as for the first time in an alarming manner in several additional counties in this State this year indicates that the organism may not be arrested by ecological factors. That these soils continue to supply the nutritional requirements of the fungus is clearly shown by the longevity of the fungus in them. Studies on the rapidity of dissemination of the fungus indicate that the primary means of spreading is through soil moved from one area to another, which suggests that every precaution should be taken toward

preventing animals from roving in the infected areas as well as the taking of plants from infected soil areas to farms where the soils are not infected. Since water is of considerable importance in spreading the fungus from infected to non-infected soils, lands should be well terraced to prevent overflows.

Since the chemical and biological factors of the infected soils are not clearly understood one course of approaching the control of the fungus appears to be the possible effects of certain chemicals on the fungus, especially those that exert certain toxic effects and that change the soil reactions. It was assumed in the beginning that for any practical solution of the problem obtained by using chemicals, that unsatisfactory changes in the composition of the plant, especially the leaf, would necessarily have to be avoided. However, it seems unlikely that any extremely unfavorable composition would

FIGURE 1.

occur, since the plant seems to have considerable balancing power over the accumulation of minerals taken into the tissues.

For the past five years a large number of chemicals, including compounds of sulphur, copper, manganese, potassium, mercury, naphthalene, calcium, iron, and formaldehyde were used on infected soils near Walkertown. These compounds were applied in the furrow, broadcast, and on the roots and stems. The chemicals were applied immediately, four weeks and one year in advance of planting the tobacco. The variety of tobacco used was previously selected because of its very susceptible qualities.

The results have indicated that organic mercury, copper sulphate, sulphur and ferrous sulphate reduce the infecting powers of the causative fungus. Sulphur applied as a dust on the roots and stems just before planting in the furrow and broadcast has reduced infection. The results following the broadcasting of sulphur are shown in Figure 1. In the foreground the check plot shows nearly all plants killed. They died soon after transplanting. In the second plot where 200 pounds of sulphur to the acre were used all of the plants

are diseased, but the effects were delayed as compared with the early losses on the check plots. In the background, where 400 pounds of sulphur to the acre were used only slight evidence of the disease was shown at the beginning of the harvest period. Despite the possibility of controlling the disease with sulphur, it may never be practical to use it, since it increases the acid reaction of the soil to such an extent that the tobacco does not grow normally. It remains green in character much beyond the normal harvesting period and is frequently badly stunted, especially when the reaction of the soil changes from pH 4.8 as occurs on the check plots, to pH 3.2 to 3.8 on plots where 400 to 800 pounds of sulphur to the acre is applied. However, it was shown in these studies that 400 pounds of sulphur to the acre caused much less disturbance of the physiology of the plant on Cecil soils than the same amounts on Granville and Durham soils.

In every instance where lime was applied to the soil the infection was advanced. The early and heavy losses following liming may not be significant in view of complete losses also occurring on untreated plots, since liming the soil caused an early stimulation of plant growth.

The fact that promising but not yet satisfactory control has been obtained by applying chemicals to the soil, indicate that the expectancy of finding such a chemical method for the practical control of the disease is not impossible.—R. F. Poole.

COTTON INVESTIGATIONS

Fertilizer experiments with cotton.—Recently the following publications and papers have been prepared giving the results of these investigations: "Experiments with Nitrogen Fertilizers on Cotton Soils", U. S. D. A. Technical Bulletin 452, 1934; "Acid-Neutral Fertilizer Comparisons," presented to the sections on Fertilizers of the American Society of Agronomy, 1934; "Fertilizer Reaction, Soil Amendments and Crop Production", Transactions of the Third International Congress of Soil Science, Vol. 1, 1935.

Crop response to acid-neutral fertilizers and its relation to the reaction of the soil has been studied on the principal soil types used for cotton production in North Carolina. From these investigations it seems that in determining the efficient use of acid forming fertilizers of low or high concentration on cotton soils of North Carolina, the chemical composition and the reaction of the soil, as well as the nutrient requirements and acid tolerance of the crop, must be taken into consideration. (Cooperation Bureau of Plant Industry, J. J. Skinner, H. B. Mann and cooperating growers.)

Cotton fertilizer placement experiment.—This experiment, located at the Upper Coastal Plain Station on Norfolk sandy loam soil was started in 1931 to study the effects upon germination, growth, and yield of cotton with the fertilizer placed in different positions and at different distances from the seed. Reports on the project have been made before the section on Fertilizer Placement of the American Society of Agronomy and published by the National Fertilizer Association in 1932, 1933 and 1934.

From 1931 to 1933 inclusive, practically the same placements were used. The results from the experiments showed consistently greater efficiency from the fertilizer when applied in bands to each side of the seed rather than directly under the seed as is the general practice. There was a direct

correlation between the amount of injury and the total soluble salts around the seed and seedlings.

In 1934 the outline was revised, some of the placements that had proven to be of little value were dropped and others added. As conducted in 1934, the experiment compares the efficiency of fertilizers when applied: (1) in a narrow band at various depths below the seed; (2) in a band to one side of the seed; (3) in contact wtih the seed; (4) mixed with the soil below the seed; (5) in bands to each side of the seed; (6) at varying rates per acre below and to each side of the seed; and (7) bedded on two weeks before planting.

As in previous years, the placements to the side of the seed were superior to all others. Placement to only one side of the seed gave practically as good results as when the fertilizer was applied on each side of the seed. From the standpoint of germination, earliness and final yield, the best placement of fertilizer for cotton is in bands 2.5 inches to each side and two inches below the seed. Good results were obtained by applying the fertilizer and bedding on it about two weeks before planting. Where the side-application is not used this practice is recommended. (Cooperation Bureau of Agricultural Engineering, H. B. Mann, G. A. Cummings, and R. E. Currin, Jr.)

At Central Station (Cecil sandy loam)

A study of the effects of varying the ratio of inorganic to organic sources of nitrogen in a complete fertilizer upon the yield and quality of cotton (Field W-1).—In this experiment the results show that 80 per cent of the nitrogen from inorganic sources and 20 percent from organic sources in a fertilizer analyzing 4 percent nitrogen, 10 percent phosphoric acid, and 4 percent potash has produced larger and more profitable yields for seven consecutive years than have other proportions tried out.—(C. B. Williams and W. H. Rankin.)

A study of the relative value of superphosphate, colloidal phosphate and open hearth basic slag for cotton (Field X).—When the same amounts of phosphoric acid are compared from superphosphate, colloidal phosphate and open hearth basic slag, the yields of cotton produced from superphosphate have exceeded those produced from colloidal phosphate or basic slag as individual carriers of phosphoric acid in a complete fertilizer mixture.—(C. B. Williams and W. H. Rankin)

A study of methods of applying concentrated fertilizer to cotton (Field S-3)—(Conducted in cooperation with the Federal Bureau of Plant Industry).—From ten methods used, it has been found that fertilizer placed three to four inches to the side of the seed row has produced superior stands and increased the yields over the methods tried out. It has also been found that seed placed in direct contact with fertilizer are often damaged before and during the germination process which has resulted in inferior stands and low yields. This experiment was discontinued at the end of the 1934 season. (Cooperation Bureau of Plant Industry, J. J. Skinner, W. H. Rankin and R. J. Harris.)

Outlying Field Experiments.—A study of potash deficiency of cotton in the peanut belt of North Carolina.—This project was initiated in the spring of 1935 on five farms in Northampton County where potash deficiency (rust) was known to be very severe on cotton the previous year. Observations and

field notes indicate that by the use of sufficient potash the loss in yield and quality of cotton may be materially reduced if not entirely prevented.—C. B. Williams and W. H. Rankin.

A study of cotton varieties and strains with special reference to new types that may be introduced into the cotton production program of the state.—Thirty-five varieties and strains were grown in tests conducted during 1934. These included the leading varieties now being grown in the State, new varieties and strains developed by breeders, and also varieties of doubtful value, seed of which are being sold in the State. Data was secured on yield, earliness, length and uniformity of staple, lint percentage and other qualities. Leading varieties in both yield and money value were Mexican, strains 128-6 and 87-8; Coker Cleveland 884-4; Coker Cleveland 5-5; and Farm Relief, strain 2. These varieties produce 1 to 1-1/16 inch staples, the lengths in greatest demand by the mills of the State. The Mexican strains and Coker Cleveland 884-4 produce lint of unusually high spinning quality as shown by recent spinning tests.

The regional cotton variety test conducted at the Piedmont Branch Station, near Statesville in cooperation with the Division of Cotton and Other Fiber Crops, Bureau of Plant Industry, U. S. Department of Agriculture, included sixteen varieties. Compilation of the data on this test has not as yet been completed.—P. H. Kime.

Cotton Breeding with special reference to meeting the needs of the manufacturers of the state.—In this project, started in 1917, breeding methods have been principally line selection with the Mexican variety. Variety hybridization as a means of developing new types for commercial production has not been undertaken. Crosses have been made between distantly related strains of the same variety, but this method seems less promising than line selection. Breeding work with the Mexican variety is being carried on at the Central and two branch station farms. Strain No. 128-6 is being grown at the Central and Piedmont stations and seed are being distributed to farmers. This strain stands high in the variety tests, especially in the Piedmont area and has shown very high spinning quality. The fiber is uniform in length, medium fine and strong.

Twenty later selections were put in the advanced strain test at the Central and Piedmont stations in 1935. At the Coastal Plain branch station near Rocky Mount, strain No. 87-8 is being grown and distributed to farmers. It stands at the top in variety tests in both yield and money value, and has good spinning quality. The staple is 1/32 of an inch shorter than 128-6 and the fiber is slightly coarser. Thirty more recent selections were put in the advanced strain test in 1935.—P. H. Kime.

A study of hybrid vigor in crosses between strains of the same variety of cotton.—This experiment was begun in 1929. Crosses were made between different strains of Mexican cotton. These strains differed slightly in plant and boll characters and in some cases 1/16 inch difference in staple length. Slightly increased vigor was noted in the F_1 generation of some crosses, and the F_2 showed a little more variation than the parent strains, particularly in staple length. Line breeding has been practised for two years in order to secure uniform staple length. Plant-to-row progenies grown

in 1934 were no more promising than selections made from the parent strains. —P. H. Kime.

Cotton Fiber Research Studies

Relation of fiber properties to spinning quality.—A study of the physical properties of fibers in several improved cotton varieties and the influence of these properties upon the manufacture of yarn is being made. The main object of this project is to evaluate fiber properties in spinning tests. This work was started in 1932, when nine strains of cotton were planted at Youngsville and grown under similar conditions. Cotton grown from seven of the strains in 1932 has been spun into yarns, and most of the fiber measurements have been made. The seven strains were grown again with the plats replicated during 1934, and the lint from them has been manufactured into yarns; fiber studies of this crop are now under way.—(J. H. Moore, in cooperation with R. T. Stutts and J. B. Robbins, Bureau of Plant Industry, U. S. Department of Agriculture.)

Internal changes of fiber properties in a standard cotton variety.—Studies are being made to note any internal change in a pure variety of cotton when selfed over a period of several years. This work was begun in the 1931 crop. Comparisons are being made of the crops of 1930, 1931, 1932, 1933, and 1934 during the year to measure any changes to date.—(J. H. Moore.)

The value of single lock samples as a measure of seed purity in cotton.—The inheritance of combed staple length as based on the random selection of a single lock from each parent plant was studied for one season (1931) in four American upland strains (Gossypium hirsutum L.), showing various degrees of variability of combed staple length. (A complete account of the results has been published in the Journal of the American Society of Agronomy, 26: page 781.) This investigation was continued during 1934, when six strains were grown to furnish material for further measurements, which are to be made as soon as possible.—(J. H. Moore.)

Effect of erosion upon fiber and seed properties.—The object of this experiment is to study the influence of soil erosion upon fiber and seed properties in cotton samples taken from the erosion plats at the Statesville Erosion Farm. Three of these were desurfaced (top soil removed); one of them was planted to continuous cotton, and the other two were planted to a two-year rotation of corn and cotton (rye and vetch to be planted after cotton and corn). Seven of the plats were left normal (no top soil removed); four of these were planted to a four-year rotation including wheat, lespedeza, cotton, vetch and rye; and three were planted to continuous cotton. These investigations were started in 1931, and four crops have been grown. Measurements of seed and fiber properties in these crops have been made and the data summarized in a large table. These results indicate that a lower seed weight, a lower lint index, and a weak fiber strength were usually associated with the desurfaced plats (continuous cotton) in a comparison with the other plat treatments. Thus far the data do not show any correlation of differences in plat treatments with differences in lint percentage, fiber weight per inch, staple length, and per cent of oil and ammonia in the seed.—(J. H. Moore.)

The influence of illumination upon the structure of the cotton fiber cell well.—The main object of this problem is to determine whether the stratification characteristic of the cell wall of the cotton fiber is the result of a daily periodicity in the growth of the fiber resulting from the alternation of day and night. In the spring of 1934 seed of two cotton strains were planted in 4-gallon pots and fertilized according to common field practice. When the plants began to bloom ten were placed under constant artificial illumination. Only those bolls which had set under normal conditions stayed on the plants. Fairly successful results were obtained in growing bolls (set under normal conditions) under artificial illumination. These bolls and those grown under normal conditions have been preserved for studies of the fiber structure in order to show the details of fiber structure, fibers grown under constant illumination were treated with reagents that produce swelling. Examination of these fibers under the microscope indicates that their cell walls possess stratification (layers or lamellae) similar to that characteristic of the cell walls of fibers grown under normal conditions. During the summer of 1935 cotton plants were grown under intermittent light (30 minutes of light and dark periods) in an effort to obtain normal cotton bolls and fully developed fibers. Fibers were obtained from the plants and are now being studied to determine the influence of the periodic illumination upon the fiber structure. Fibers obtained from the plants grown under artificial illumination were characterized by very thin walls, and further work is now in progress with the object of growing fully developed fibers under artificial illumination.—(D. B. Anderson and J. H. Moore.)

Origin and Early stages of elongation in the cotton fiber.—The main object of this project is to study the origin of cotton fibers on the cotton seed and to note any division of cells in the epidermal layer of the ovule subsequent to fertilization. Seed of naked and fuzzy seed strains were planted in the field in 1934, and grown under normal cultural conditions. Daily stages of the fruit ranging from the flower buds to mature bolls have been fixed by several methods in several different fixatives. Examination of the material has shown definitely that numerous cell divisions occur in the epidermal layer after the date of flowering. Work is now under way to determine whether any of these cell divisions in the epidermal layer lead to the formation of cotton fibers.—(J. H. Moore and D. B. Anderson.)

Influence of Potash Deficiency "Rust" upon the yield and quality of cotton.—In the fall of 1934 there was very severe "rust" damage to cotton grown in the peanut section of the State. A preliminary survey made by the Agronomy Department showed that the average amount of "rust" injury during the season caused a marked decrease in boll size, seed weight and lint index. On the basis of boll size alone, the injury was responsible for a 28 percent decrease in yields. The results of fiber quality studies indicated that rust damage was usually associated with a shorter staple length, a weaker fiber and a lower grade. Judging from field observations and interviews with a number of farmers whose cotton was severely damaged in 1934, this trouble is generally believed to be more prevalent on soils that have been limed heavily, have poor drainage, have had a number of legume crops removed, or are naturally alkaline or near alkaline in reaction. As a result of the preliminary investigations, five of the farms visited were

selected for making tests to determine the influence of the use of varying amounts and kind of potash salts upon the yield and quality of cotton lint. These fields were planted to one standard variety of cotton in 1935 and the fertilization on each farm was similar. Yields of each plat and treatment are being measured, and bolls have been saved for the study of fiber quality. —(W. H. Rankin and J. H. Moore.)

Grade and staple of North Carolina cotton.—This study, started in 1928, is carried on annually in cooperation with the Division of Cotton Marketing, Bureau of Agricultural Economics, United States Department of Agriculture. This study is designed to furnish data on the quality of cotton produced annually in North Carolina. In addition to the annual reports, weekly and monthly reports are published throughout the ginning season giving the grade and staple of the current crop. Cooperators are given the classification of individual bales. The grade and staple of the cotton ginned by 62 gins which cooperated in this work for the 1934-35 season is shown in Table 1. The State is divided into three distinct cotton producing regions: (1) Tidewater, (2) Upper Coastal Plain, and (3) Piedmont. (A map of these areas was published in the Fifty-third Annual Report, page 36.)

TABLE 1.—AVERAGE PERCENTAGE OF GRADES AND STAPLE LENGTHS GINNED IN NORTH CAROLINA BY REGIONS, 1934-35.

Region	White and Extra White		Other Grades	15-16″ and over	7-8″ and 29-32″	Under 7-8″
	Middling and Above	Strict Low and Low Middling				
	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)
I	36.2	51.5	12.3	57.3	40.0	2.7
II	75.7	17.3	7.0	72.7	26.0	1.3
III	75.8	2.3	21.9	78.4	21.4	0.2
Average	70.9	17.3	11.8	72.4	26.4	1.2

The staple length of North Carolina cotton has gradually improved since the beginning of the grade and staple estimate work in 1928. Except for the crop of 1933-34 each successive crop has had a larger percentage of one inch and longer staple than the preceding crop. The staple length of the 1934-35 crop is the best on record. The grade was also higher than in 1933-34. The greatest improvement in both grade and staple was in the Coastal Plain and the Piedmont regions.—(Glenn R. Smith.)

Relationship between moisture content of cotton and Gin Preparation. —The preparation of each sample classed in connection with the grade and staple estimate work has been recorded for the past two seasons. These data are being analyzed in an attempt to determine what factors make for poor preparation and lower grades. Data on the weather and the water content of the cottonseed are being used in the analysis. There is a direct relationship between the percentage of cotton with poor preparation and rainfall during the picking and ginning season. A given amount of rainfall

is much more effective early in the season, however, than late in the season. Table II shows monthly rainfall, the percentage of monthly ginnings, and gin damaged for the falls of 1933 and 1934.

TABLE II.—PERCENTAGE OF MONTHLY GINNINGS GIN DAMAGED AND AVERAGE MONTHLY RAINFALL, FALLS 1934 AND 1933.

Months	Gin Damaged		Average Rainfall	
	1934	1933	1934	1933
	(Percent)	(Percent)	(Inches)	(Inches)
September	27.3	7.5	6.11	2.74
October	11.2	3.5	1.69	.93
November	2.9	1.6	4.61	.91
December	0.9	2.3	2.63	1.24

The percentage gin damaged was considerably greater in 1934 than in 1933. Likewise the rainfall was greater in 1934.—(Glenn R. Smith.)

Cotton Marketing Practices in North Carolina local markets.—A study of local buying and selling practices, dealing primarily with ginner buyers, was completed and the findings made available in Agricultural Experiment Station Technical Bulletin No. 51. A comprehensive summary of this study was given in the Fifty-Sixth Annual Report of the North Carolina Agricultural Experiment Station.—(Glenn R. Smith.)

CORN FERTILIZATION AND IMPROVEMENT

A study of the rates of application of different forms of lime for corn grown on peat soils when used with and without fertilizer (Field L).—The results from the 1934 corn crop further substantiate the findings of previous years that ground limestone is the most efficient source of lime, while hydrated lime and marl are second and third in efficiency, respectively.

A complete fertilizer used in addition to lime has produced a profitable increase in yield, while a complete fertilizer without lime has produced yields less than lime alone. The plats that have had no lime treatment are almost entirely barren of crop growth, due to excess acidity, showing that the use of lime is highly essential for crop production on this soil.—C. B. Williams, W. H. Rankin and J. L. Rea, Jr.

Effects of the use of lime and potash on the yield of corn when lime is applied broadcast at four-year intervals and when applied in the drill annually in one-fourth the quantities that are applied each four years on peat soil (Field J).—One year's results from this experiment give no indication of what may be expected from these treatments.—(C. B. Williams, W. H. Rankin, and J. L. Rea, Jr.)

Corn Improvement.—Variety tests were conducted at the Mountain branch station and at the Coastal Plain branch station. Varieties producing the best yields of seed at the Mountain branch station were Holcombe's

Prolific, Southern Beauty, and Biggs' Two Ear in the white group, and Jarvis Golden Prolific, Hood's Yellow, Golden Queen and Indian Chief in the yellow group. At the Coastal Plain branch station the best white varieties for seed production were Latham's Double, Biggs' Two Ear, Cocke's Prolific, and Wood's Dixie; in the yellow class, Jarvis Golden Prolific and Indian Chief. For silage purposes, Coker-Garrick, Latham's Double and Highland Horsetooth have shown up as the best producers.

The development of a yellow corn suitable for silage is being attempted at the Central Station. Our yellow corns are medium early and do not make a large growth, while some of the silage types produce very poor yields of seed. The ideal silage type is one which produces a heavy tonnage of silage and at the same time produces a fair to good yield of seed, thus giving both quantity and high feeding value.

Garrick, a white silage and general purpose corn, was crossed on Golden Queen. The hybrid yellow seed were crossed back to the Garrick for three years, then the ears were self-pollinated in order to isolate the pure yellow seed.—(P. H. Kime and W. E. Adams.)

Intercropping of Corn and Soybeans.—This experiment was begun in 1930. The practice of intercropping corn and soybeans is used extensively in the Coastal Plain area, and to some extent in other parts of the State. This experiment was designed to determine the effect of intercropping on the yields of both corn and soybeans. Corn yields were reduced about 25 percent when the corn was planted in four-foot rows with beans in the same row, and about 38 percent when the corn was planted in six-foot rows with a row of beans between the corn rows. The combined yields of grain and soybeans were slightly less than from corn alone, but the total value was about the same, soybeans being worth more per bushel than corn.—(P. H. Kime and W. E. Adams.)

SMALL GRAIN IMPROVEMENT

Testing and Breeding of varieties.—The small grain investigations are carried on principally at the Piedmont branch station near Statesville. Wheat varieties are also being tested at the Mountain branch station near Swannanoa. Several varieties, and in some cases several strains of the same variety, were tested at the Piedmont station during the past year. The varieties and the number of strains of each variety are listed below:

Fulcaster—8 strains
Leaps' Prolific—7 strains
Greason—9 strains
Alabama Blue Stem—3 strains
Purple Straw—2 strains
Redhart—3 strains
Forward
Arlando.

The winter of 1934-35 was mild and there was practically no winter injury. During this year rust infection was the heaviest in several years. In the tests the varieties ranked according to rust-infection were as follows: Leaps' Prolific (heaviest), and Redhart, Alabama, Blue Stem, Purple Straw, Arlando, Forward, Fulcaster and Greason (least). The selections within

any given variety showed some variation in rust infection. Results of several years tests show that Fulcaster, Leaps', Greason and Alabama Blue Stem are the best varieties for the Upper Piedmont area of the State. Redhart does well when winter injury does not occur; it is well adapted to the Coastal Plain and border counties. At the Mountain Station Fulcaster and Leaps' Prolific have proven to be best adapted.

The oat variety test included Lee, Norton, five strains of Fulghum, three strains of Red Rust Proof, ten strains of cold and smut resistant selections from Coker Pedigreed Seed Company, and Burt. Winter injury ranged from none to ten per cent. Highest yielding varieties were Lee, Winter Fulghum Nos. 2498 and 2500, Appler No. 294, Nortex 2382, and Coker Nos. 33-47, 33-50, and 34-1. The Lee is the most winter hardy and has led in yield over a period of several years, followed by Norton, Fulghum and Appler.

The breeding work with wheat during the past year was confined to testing of strains previously selected. These were tested along with the varieties and have already been discussed.

A large number of oat hybrids, secured from the Division of Cereal Crops and Diseases, of the U. S. Department of Agriculture, are being grown. These are bulk hybrids in the 5th and 8th generations. A number of these crosses were between a winter-hardy variety and a non-winter hardy crown rust resistant variety, such as Victoria and Sunrise. Eight hundred selections from these hybrids were seeded in October, 1934, some of which showed considerable promise. Many of the selections from hybrids which had Victoria or Sunrise parentage winter-killed badly. No crown rust was found on any of the oatwork on this station. Severe injury from this disease is usually limited to the Coastal Plain area of the State.—(P. H. Kime and W. E. Adams.)

Wheat Breeding for Rust Resistance.—Several years ago a large number of hybrids, varieties and strains of wheat which showed resistance to leaf rust, were sent to this station by the Federal Division of Cereal Crops and Diseases. The less desirable of them, from the standpoint of yield, resistance to rust and cold injury and other undesirable characters have been discarded. Thirty-three of the more promising were grown during the season of 1934-1935. Twenty-four of these showed less rust infection than the Fulcaster check, and eleven of these yielded as good or better than Fulcaster; while only three of those showing as much or more rust than the Fulcaster yielded as well. The more promising are Malakof X Penn. 44, P 1066-1 X Gladden, P 1066 X Grand Prize, and crosses having either Fulcaster, Leaps' or Purple Straw for one parent and P 1066 or P 1068 for the other parent.—(P. H. Kime, S. G. Lehman and W. E. Adams.)

Wheat Rust.—The work on this project was favored in the summer just passed by an unusually severe rust epidemic. The high incidence of rust brought into marked contrast the inherent abilities of different wheat hybrids to resist this disease and made easier the task of selecting individual rust resistant plants. Approximately 1600 plants of the F_3 generation were saved because of their apparent high rust resistance and other characters perceptible in the field. These plants were thrashed individually and further selected on the basis of seed characters. Of a considerable number of these whose F_2 parents seemed not to be segregating further, enough seed was obtained for a preliminary yield test for planting in the fall of 1935. Approx-

imately 125 more recent hybrids in the F_1 and F_2 generations are also available for further selection. In addition to the above somewhat more than 500 individual head selections were made for rust resistance from bulked hybrid plantings.—(S. G. Lehman.)

Barley seed treatment.—Barley seed was treated with a commercial preparation containing ethyl mercury phosphate. This material was applied as a dust at the rate of one-half ounce per bushel of seed. The seed was planted on land which had been in lespedeza for several years. The treatment resulted in no significant increase or decrease in stand of plants as determined by fall and spring counts. Seed dipped in formaldehyde solution 1-320, and kept moist 5 hours before drying was decreased 8.75% in stand of seedlings as determined by fall count, the reduction being mathematically significant. Both treatments gave almost complete control of covered smut and, apparently, slight reduction of the form of loose smut present.—(S. G. Lehman.)

EXPERIMENTS WITH FORAGE CROPS

Soybean variety experiments.—Some variety test work is being done at the Central station farm. Testing of varieties and new introductions at the Coastal Plain branch station at Willard and the Piedmont branch station, near Statesville, is now being continued in cooperation with the Division of Forage Crops of the Federal Bureau of Plant Industry. Testing of new varieties, originating in this country, and quite a number of foreign introductions, together with standard varieties was continued at the Central station farm in 1934.

Some of the new introductions showed promise for either hay or seed production. The Mamloxi (Delta Experiment Station) was a heavy yielder of seed and did not shatter badly. Several edible varieties were also grown, some of which were very heavy seed yielders.—(P. H. Kime.)

Soybean breeding for increased yields and other desirable characters.—The varieties producing the heaviest yields of seed are subject to shattering, and heavy losses of seed often occur if they cannot be harvested immediately after maturity. Breeding work at the present time is devoted largely to the development of non-shattering yellow-seeded types. A yellow-seeded type has been isolated from a natural hybrid. It has the plant and pod characters of the Biloxi and is non-shattering. A few seed of this selection have been distributed. Some other very promising selections are now being tested. They also appear to be hybrids between Biloxi and some other variety. Some slightly off type but promising selections from the Mammoth Yellow variety are being tested.—(P. H. Kime.)

Adaptation of different sources of red clover seed to the Mountain area of North Carolina.—This experiment was begun in 1934 and fifteen lots of American-grown seed from various sources were seeded during March of that year. Stands were rather poor and spotted, due to dry weather the following May. Growth during 1934 was fair and very little disease was observed. Records will be secured on growth, disease and other factors during the season of 1935.—(P. H. Kime.)

Effect of time of cutting and number of cuttings on the stand, growth, yield and quality of hay from lespedeza sericea.—This experiment was started in the spring of 1933 but a poor stand was secured, due to dry weather. It was reseeded in 1934 and a good stand secured. It is making a good growth in 1935, and cuttings at various dates will be made.—(P. H. Kime.)

Forage Crop Work in Cooperation with the Division of Forage Crops, U. S. Department of Agriculture

This work is being carried on at the Piedmont Branch Station under the supervision of R. E. Stitt, of the Division of Forage Crops and at the Coastal Plain Branch Station, by W. H. Stewart, Jr., of the same division.

Projects being carried on at the Piedmont branch station are as follows:

(1) A study of the comparative value of American-grown and imported varieties and strains of alfalfa.—In this experiment hay yields were secured on four variety, strain and source of seed tests. These tests were seeded in the fall of 1930, 1931, 1932 and 1933, respectively. The common variety from Kansas, Dakota and Utah have generally proved best. Certain lots of seed from Italy, Oklahoma and New Mexico have also proven to be high yielders. Grimm and Hargigan also did well. In the test seeded in September, 1933, Hairy Peruvian and certain lots from Arizona and California winter-killed badly during the severe winter of 1933-34. If these nonhardy strains survive the first winter they seldom winter-kill very much during later years.

(2) A study of hay yields and adaptability of American and foreign lots of red clover seed.—This experiment was seeded in March, 1934, good stands being secured and an excellent growth made in the spring of 1935. There were marked differences in growth and adaptability.

(3) Soybean variety experiments.—A large number of new introductions have been grown for several years. Some of the more promising have been put in the advanced test.

(4) Studies of crimson clover and vetch in rye mixtures for pasture.—Crimson clover seeded during August or early September furnished considerable grazing. Rye seeded the same date needed to be grazed within six weeks to prevent jointing. Hairy vetch did not make enough growth to supply fall grazing.

Other projects being carried on at the Piedmont Branch Station are—(1) Annual lespedeza for soil improvement; (2) Effect of fertilizer and lime on the growth of lespedeza; (3) Lespedeza sericea for pasture; (4) Lespedeza sericea for hay production; and (5) Alfalfa versus lespedeza sericea for hay.

At the Coastal Plain Branch Station the following projects are being carried on: (1) A study of winter legumes as cover and green manure crops; (2) A study of methods of securing stands and growth of hairy vetch; (3) A study of the effect of continuous cropping on forage and seed yields of crotalaria; and (4) Soybean variety tests, including a large number of new importations.

PEANUT FERTILIZATION AND IMPROVEMENTS

At the Upper Coastal Plain Branch Station (Norfolk sandy loam)

A study of the influence of certain dusts and sprays upon the growth, yield, and general characteristics of peanuts.—These investigations, started in 1929, have been expanded to include greenhouse, concrete frame and yield experiments to determine the effects of dusts, fertilizers, lime and soil amendments upon (1) bases absorbed by peanut plants; (2) number of blooms and duration of blooming period; (3) nodulation of plants; (4) number of "pegs" and their relation to blooms; (5) size, quality and shelling percentage and yield of nuts; (6) reaction of the soil; (7) total soluble salts in the soil; (8) exchangeable bases in the soil; and (9) the availability of calcium from various materials to peanut plants on different soil types.

Two publications covering phases of this work have been prepared. North Carolina Agricultural Experiment Station Bulletin No. 281, giving approved practices for peanut growers, was issued in 1933. Paper No. 82, of the Journal Series of the Experiment Station, "The Relation of Soil Treatment to the Nodulation of Peanuts," has been accepted by *Soil Science* for publication.

Calcium carbonate applied at the rate of 2000 pounds per acre to virgin Norfolk (pH 5.3) and Coxville (pH 4.5) soils increased nodulation of peanuts throughout the growing season. Similar applications to a cultivated Norfolk soil that had been previously limed to pH 6.6 did not increase nodulation. During the latter part of the growing season there was a slight reduction of peanut nodulation from the use of calcium carbonate on the soil. Varying applications of calcium carbonate to virgin acid soils had quite different effects upon peanut nodulation. Moderate applications stimulated and increased nodulation, but heavy applications retarded and reduced it. These results offer an explanation for the conflicting reports as to the effect of lime on legume nodulation. Calcium sulphate broadcast at the rate of 2000 pounds per acre delayed and reduced nodulation on all soils studied. Probably due to the high acidity produced, sulphur applied at the rate of 400 pounds per acre prohibited nodulation of peanuts at all stages of growth.

As in previous years, peanuts grown on acid soils low in calcium were improved by applications of calcium sulphate on the foliage at blooming time. Similar applications to peanuts, growing on heavily limed or soils well supplied with calcium, were ineffective. The response of peanuts to calcium sulphate seems to be due to the available calcium supplied by the calcium sulphate.—(H. B. Mann and R. E. Currin, Jr.)

A study of factors which influence the size and quality of peanuts.—In this project which has been active since 1926, selection work with the Virginia Bunch variety is being continued on the Upper Coastal Plain Branch Station at Rocky Mount. Fifteen selections were grown in the strain test in 1934. These have survived after discarding a large percentage of the plant-to-row selections and the less promising strains. These selections show considerable differences in yield, percentages of handpicks and large nuts, and in total production of handpicks and shelled nuts. The strains grown during the past year showed an improvement over the parent variety in one or more of the above characters and in uniformity of pod and seed size.

Two other strains which have been in the yield test only one year are promising from the standpoint of yield, size and quality.—(P. H. Kime and R. E. Currin, Jr.)

LIVESTOCK INVESTIGATIONS

Retarded growth in Swine V.—The relation of rate of growth in pigs, when controlled by level of feeding, to the production and quality and palatability of their meat was studied with three groups of pigs, and they were hand fed as follows:

Group a—full fed from weaning to slaughter in dry lot.
Group b—limited on pasture to 100 pounds, then full fed in dry lot to 225 pounds.
Group c—limited on pasture from weaning to 225 pounds.

Groups a, b, and c, respectively, required for the total period 419 pounds, 384 pounds, and 340 pounds of feed to produce 100 pounds gain, and were on feed a total of 140, 189, and 379 days before attaining an average slaughter weight of 225 pounds. The carcasses of all pigs in groups a and b that were finished to 225 pounds were graded hard, but from Group c only one carcass was hard, one medium hard, and six medium soft. Samples of fresh roasted pork from the three groups when scored for palatability showed significant differences between groups a and b in only two cases, namely, that the flavor of the fat was more pronounced and the aroma was more desirable in the meat from Group b. The meat from Group c pigs averaged one grade lower than that from Group b in six instances, 2 grades lower in one case, and for three of the values the grade was the same.—(Earl H. Hostetler and John E. Foster, Cooperation Bureau of Animal Industry.)

Effect of Feeding Various amounts of soybeans to Pigs, II.—A comparison was made of pigs fed individually and in groups, rations containing 30, 40, and 50 percent ground soybeans to weights of approximately 100 pounds, then finished to 225 pounds on a corn ration containing 13% of cottonseed meal. The feed consumption per unit of gain was rather high in all groups, but especially so during the first period when the group fed pigs receiving respectively, 30, 40, and 50 percent of soybeans in the ration required for each 100 pounds gain 421 pounds, 497 pounds, and 451 pounds of feed. The firmness of the carcasses of all pigs was satisfactory. In fact, all pigs were graded hard except one of the group fed pigs that received 30% of soybeans, and it was graded medium hard.

The carcasses yields were apparently unaffected by the amount of soybeans in the ration, since the average thickness of back fat, 47.7 mm., was found to be greatest in the individually fed pigs receiving 30% soybeans, also the average thickness of back fat, 43.3 mm., was least in the pigs that were group fed 30% soybeans. The average for the other four groups ranged from 43.4 to 47.3 mm. The dressing percent or weights of the different cuts from carcasses of pigs that had been fed varying amounts of soybeans did not show any correlation with the ration.—(Earl H. Hostetler and J. O. Halverson, Cooperation Bureau of Animal Industry.)

Utilization of Crops by two different methods.—Three one-acre plats were seeded to cotton and when harvested yielded, respectively, 874 pounds, 1209 pounds, and 910 pounds of seed cotton. Since work on this project was

begun plats 1 and 2 have been fertilized in the same way, but the edible crops on Plat 2 have been "hogged off." The edible crops on Plat 3 have also been "hogged off", but the fertilizing value in the supplementary feeds fed has been deducted from the fertilizer application applied to the succeeding crop.—(Earl H. Hostetler and H. B. Mann, Cooperation Upper Coastal Plain Station.)

Protein supplements for fattening pigs.—Two trials were conducted during the past year comparing mixtures of varying amounts of fish meal and cottonseed meal with fish meal alone as supplements to shelled corn. Sixty-four pigs were divided into four equal groups in the first trial, and the test was repeated in the second trial with 60 pigs. The protein supplement for the pigs in Group 1 consisted of fish meal alone, for Group 2 a mixture of equal parts of fish meal and cottonseed meal, for Group 3 fish meal one-third and cottonseed meal two-thirds, and for Group 4 fish meal one-fourth and cottonseed meal three-fourths. An average of the two trials showed that pigs fed the protein mixture of equal parts of fish meal and cottonseed meal produced more rapid gains, required less feed per unit of gain and were more profitable than either of the other three groups.—(Earl H. Hostetler and J. E. Foster, Cooperation Blackland Station, Wenona, N. C.)

A study of pastures and their utilization by sheep.—Three uniform three-acre fields were seeded to the following:

Field 1—Permanent grass mixture consisting of 15 lbs. Orchard grass, 8 lbs. red top, 12 lbs. Kentucky blue grass, 5 lbs. White Dutch clover, and 5 lbs. common lespedeza.

Field 2—Abruzzi rye in the fall followed by Kobe lespedeza the next spring.

Field 3—Italian rye grass in the fall, followed by Korean lespedeza the next spring.

The Abruzzi rye and rye grass in Fields 2 and 3 each gave 9500 sheep grazing hours, but the sheep in Field 2 made 25 pounds more gain than those in Field 3. During this period each group received 200 pounds of peanut hay in addition to their grazing.

From the beginning of the grazing period on permanent pasture and lespedeza until June 30, 1935, Fields 1, 2, and 3, respectively, furnished 5807, 5795, and 6400 ewe grazing hours, and 4816, 3753, and 5533 lamb grazing hours.—(J. E. Foster, R. E. Stitt, H. N. Vinall and Earl H. Hostetler, Cooperation Piedmont Station, Statesville, and Bureau of Plant Industry.)

A study of the changes in meat and wool characteristics resulting from the use of purebred mutton rams on native ewes.—The studies carried out in the year 1934-35 gave similar results to the preceding year's studies, namely: that the crossing of either purebred Shropshire or Hampshire rams on Native ewes produced lambs that were much more blocky, thicker fleshed, and earlier maturing than their dams. The mature half-bloods sheared considerably more wool of better quality and longer staple than the Natives.

The three-quarter blood lambs and yearlings showed still further improvement over the half-bloods in type, conformation, quality and length of time required to reach market weight, but the degree of improvement was not so pronounced as in the first crosses. However, from a market standpoint these three-quarter-blood lambs compared very favorably with repre-

sentative purebred Shropshire and Hampshire lambs. The various measurements of the live animals and the carcasses also substantiates the above statement.

Both as market lambs and breeding ewes, the Hampshire crosses were somewhat larger than the Shropshire crosses, but were not as blocky, showed less quality, and did not carry quite as good fleeces. More twins were produced from the first cross Shropshires, but they were not as early as the lambs from the first-cross Hampshires.

At weaning time, July 1, the average weights of the Native, three-quarter blood Shropshire, three-quarter-blood Hampshire, and Hampshire lambs, respectively, were 35 pounds, 61 pounds, 73 pounds, and 77 pounds.

The coming season the trials will be repeated and the second cross (three-quarter-blood) ewes will be bred to purebred rams of their respective breeding.—(J. E. Foster and Earl H. Hostetler.)

Comparative study of quality of meat of Native versus Grade Hereford yearlings.—The following conclusions were drawn from the results of four separate trials in connection with this project.

(a) Grade Hereford calves (Hereford x Natives) gained .14 lb. more per day during the summer than Native calves and weighed 53 lbs. more when weaned in November.

(b) Grade weaned calves gained .15 lb. more per day during the winter than the Natives, but there was no appreciable difference in their gains the following summer.

(c) Grade yearlings made 62 lbs. more gain per head in the feed lots than the Natives.

(d) Eleven percent more concentrates and 6 percent more soybean hay were consumed per head daily by the Grades, but the Natives required 13.5 percent more concentrates, and 17 percent more soybean hay to produce 100 pounds of gain.

(e) The cost of gains was $1.31 per cwt. cheaper for the Grades.

(f) The dressing percent was 1.09 higher for the Grades than for the Natives.

(g) The Grade Herefords graded one full grade higher than the Natives as feeders, slaughter cattle, and in the carcass.

(h) The differences as brought out by the laboratory, cooking, and palatability tests, where any, were slightly in favor of the Grades.

(i) Everything being taken into consideration, the use of pure bred bulls greatly increased the profitableness of the enterprise.—(Earl H. Hostetler and J. E. Foster, Cooperation Blackland Station, Wenona, and Bureau of Animal Industry.)

Value of native reeds for summer grazing.—Native reeds (Arundinaria tecta) have furnished excellent grazing for cattle at the Blackland Station, Wenona. During the past year 33 native cows and their 28 calves, sired by a Hereford bull, were grazed on reeds from May 8 to November 23, or a total of 199 days. The cows during this period made an average daily gain per head of .51 pound, while their grade Hereford calves gained an average of 1.23 pounds per head daily.—(J. E. Foster and Earl H. Hostetler, Cooperation Blackland Station, Wenona, and Bureau of Animal Industry.)

Comparative gains on reed pasture versus tame pasture.—During the grazing season of 1934 ten representative grade Hereford yearling steers and heifers were compared on tame permanent pasture with 22 similar ones on reed pasture.

The tame pasture was grazed from April 20 to October 26. During this 189 day period the yearlings made an average daily gain of 1.18 pounds.

The reed pasture was grazed from May 8 to October 26, and for this 171 day period produced an average daily gain of .81 pound.

An attempt was made to compare the carrying capacities of the two pastures also, but due to the drouth which made it necessary to move the groups to additional areas of similar pastures, and the irregular stand of the reeds, it was not possible to accurately determine this. However, as is shown above, the tame pasture was ready to graze 18 days earlier than the reed pasture. The reeds though, after May 8, furnished more grazing per acre than the tame pasture and were hurt less by the drouth.

On October 26 both groups of yearlings were turned in a reed area previously grazed by the cows, and the yearlings and cows were wintered on reeds reasonably well until January 18, at which time the cows and heifers were moved to the stalk fields on the farm. The fifteen steers averaging 594.33 lbs., were then turned in an ungrazed reed area of 32 acres and left until March 29. During this 70 day period they lost an average of .17 lb. per head daily, but were in strong condition. If they had been taken out on March 15 they would have shown an average daily gain of .14 lb., and on March 1 an average daily gain of .43 lb.

All gains from September 1 on were reduced by an outbreak of "Pink Eye."—(J. E. Foster and Earl H. Hostetler, Cooperation Blackland Station, Wenona, and Bureau of Animal Industry.)

Value of crop gleanings for wintering beef cattle.—The fifth year's gleaning studies were with 33 dry Native cows and 17 grade two-year old heifers. They were turned in the stalk fields on January 18, and removed from this area on February 27. During this 40 day period the 50 head gleaned 52 acres of corn and soybean fields, making an average daily loss of .50 lb. per head, or 19.90 pounds loss for the period. The corn had been harvested and made an average yield per acre of 34.23 bushels. The soybeans were not harvested. When the weights were taken on February 27 there were 19 young calves, so the calf weights were added to the cow weights. Here, too, as in 1934, the larger loss in weight and fewer number of cow days than in former years, was largely due to the late date at which they were turned in the stalk fields. The herd was turned into additional stalk fields on February 27, but in this area they also had access to rye grazing.

An average of the five years' trials shows that this cow herd which calved in February, March and April, practically maintained its weight on gleanings alone over an average period of about 65 days, extending from around the tenth of January to about the middle of March. Some roughage was also furnished after this date, but not enough to maintain weights.—(J. E. Foster and Earl H. Hostetler, Cooperation Blackland Station and Bureau of Animal Industry.)

A study of methods of establishing permanent tame pastures.—Two acres of land are being used that were seeded to permanent pasture in March, 1929. This land was originally swampy and covered with juniper

trees, but prior to 1929 it had been cleared and tile drained, and had produced eight crops of corn and one of cowpeas. No fertilizer has been applied, but one to one and one-half tons of lime was applied at two-year intervals. Only a fair stand of grasses was noticeable in the spring of 1934, and these consisted primarily of blue grass and lespedeza, the lespedeza having been reseeded in March, 1934.

Eighteen 1/20 acre plats have been treated as follows:

1. Manure, 4 tons per acre.
2. Manure, 4 tons per acre and 50 pounds copper sulphate.
3. Top soil, 4 tons per acre.
4. 2-8-8 fertilizer, 400 pounds per acre.
5. 2-8-8 fertilizer, plus 50 pounds copper sulphate, 400 lbs. per acre.
6. 0-0-24 fertilizer, 400 pounds per acre.
7. 0-0-24 fertilizer, plus 50 pounds copper sulphate, 400 lbs. per acre.
8. No fertilizer treatment, except lime.
9. No treatment.

Plats 10 and 18 were planted, or will be planted, to soybeans in June, 1934, 1935 and 1936. These will be plowed under during the fall of 1934, 1935, and 1936, and seeded to Abruzzi rye. In the spring of 1937 these plats will be seeded to a permanent pasture mixture and fertilizer in the same way as Plats 1 to 9. All plats except Nos. 9 and 18, will receive an application of one ton of lime per acre every other year.

At the end of the conditioning period, spring 1937, it is proposed to seed across all plats segments of pasture grasses as follows: Blue grass, lespedeza (annual), orchard grass, Dallis grass, white clover, carpet grass, and a mixture of the above minus carpet grass.—(L. I. Case and W. H. Rankin, Cooperation Blackland Station, Wenona, and Bureau of Animal Industry.)

Vitamin A studies in cottonseed meal with beef cattle.—Eight high grade Shorthorn heifer calves of similar breeding, age, type, and former treatment, were divided into four groups of two each and started on feed January 2, 1934. Each group received 26% of cottonseed meal, 26% of corn, and 1% mineral mixture. Group 1 received yellow corn, but Groups 2, 3 and 4 received white corn. In addition, the Group 1 mixture contained 22% cottonseed hulls and 25% dried beet pulp; Group 2, 27% cottonseed hulls, and 20% alfalfa hay; Group 3, 27% cottonseed hulls, and 20% soybean hay; and Group 4, 17% cottonseed hulls and 30% soybean hay.

The sources of Vitamin A were, therefore, 20% alfalfa hay, 20% and 30% soybean hay, and 26% yellow corn.

The response of the eight heifers to the ration divided them into two groups. Those receiving 20% and 30% soybean hay had been successfully fed for 372 and 377 days when they were slaughtered. Those on 20% hay had made an average daily gain of 1.81 pounds, and those on 30% 1.71 pounds.

Twenty percent and 30% soybean hay adequately supplemented the ration containing 26% cottonseed meal. This hay contained four times the vitamin A content of the alfalfa hay which was fed.

Twenty-six percent yellow corn did not adequately supplement the ration containing 26% cottonseed meal, together with beet pulp and hulls as roughage.

These two heifers showed the effects of the deficiency in about one-half to two-thirds the time of those receiving 20% alfalfa hay, and one went blind. The yellow corn contained but one-third as much vitamin A as the alfalfa hay. Upon the addition of 20% soybean hay to the ration the heifers on yellow corn recovered and gained in weight. No. 2 broke on June 5, completely blind on June 21, hay added on June 25, and slaughtered on January 24, 1935. No. 1 broke on July 3, hay added on August 14, and slaughtered on January 24, 1935. Both were in good condition when slaughtered.

Twenty percent alfalfa hay also proved inadequate in the ration over a period of 10 to 12 months feeding. However, when 10 percent additional hay was given, or a total of 30% of the ration, this proved adequate for one heifer, but it was necessary to further fortify the ration of the other heifer with cod liver oil for 80 days in order to save her life.—(J. O. Halverson and Earl H. Hostetler.)

Content of Vitamins B and G Complex in meals from high oil-bearing seeds.—Results are reported in approximate International units per gram (to May 8, 1935).

No.		*Units of Vitamin B*	*"G" Complex*
1.	Cottonseed Meal, 43% protein	5	
2.	Linseed Meal (from Buffalo, N. Y.)	6 to 7	
3.	Linseed Meal (from Cincinnati, Ohio)	4	
4.	Soybean Meal (from Decatur, Ill.)	1 to 2	
5.	Soybean Meal (from Cincinnati, Ohio)	1 to 2	
6.	Soybean Meal (from Norfolk, Va.)	1 to 2	
7.	Soybean Meal, New Process, Solvent Extraction (from Chicago, Ill.)	4 to 5	
8.	Soybeans, Mammoth Yellow	4	
8-a.	Same as No. 8, after one year storage whole or ground, in refrigerator	4	
8-b.	Same as No. 8, stored one year whole at laboratory temperature. There was probably a slight loss which was within experimental error	4	

The determination of Vitamin "G" Complex on the above samples is in progress.—(F. W. Sherwood and J. O. Halverson.)

Menhaden fish oil as a source of Vitamin D for growing chicks.—Under a confinement system of brooding it was decided to determine whether one percent of Menhaden oil will furnish sufficient vitamin D in group-feeding of chicks.

Three groups each of 100 chicks of Barred Rocks, one week old, were fed respectively:

Lot 1—1% Menhaden fish oil.
Lot 2—1% of Maize oil.
Lot 3—1% of tested cod liver oil.

The basal ration consisted of the State Starting Mash without any added cod liver oil.

TABLE 1.—AVERAGE CHICK WEIGHTS, FEED EATEN AND ASH ANALYSIS.

Av. Wt. per chick at 8 weeks		Total Feed Consumption Per Lot	Total Mortality Per Lot	"Line" Test, Calcification of 5 chicks(1)	Raw Bone (Tibia)	Dry Fat-Free Bone	Total		Per Cent	
							Ash	Calcium	Ash	Calcium
Lot	Gm.	Lbs.	%		Gm.	Gm.	Gm.	Gm.		
1	719	470.2	4	1	6.707	2.6074	1.1819	0.4415	45.41	16.97
2	399	270.9	72	2.6	3.733	1.4407	0.6300	0.2349	43.85	16.37
3	712	439.4	5	2	6.535	2.7253	1.2090	0.4473	44.51	16.47

(1) In order of descending calcification, 1, 2, 3.

One percent of Menhaden fish oil compared with 1% cod liver oil gave equally good calcification and growth. The calcification of Lot 2 receiving 1% Maize oil was also good, but growth was only 55.8% as much. The State laying mash without cod liver oil lacked some necessary ingredient for growth which was not supplied by 1% Maize oil.—(J. O. Halverson and R. S. Dearstyne.)

Dairy Cattle Pasture Studies II—Central Station.—The year 1935 was favorable for pastures. The moisture distribution was fairly uniform and the pasture used in this study carried the best cover of White Dutch clover it has ever had.

During the latter part of April some of the plats carried as high as 50% white clover and 40% Kentucky blue grass. It is very difficult to keep the plats uniform in plant cover.

No fertilizer was applied during the year 1935. Data were kept on the grazing field of each plat to study the residual effect of six years' fertilization. The following table gives the net total digestible nutrients for each plat for the year 1935.

	Plat 1	Plat 2	Plat 3	Plat 4	Plat 5	Plat 6	Plat 7	Plat 8
1935	1858.8	1680.0	1255.6	1524.8	1426.4	1530.4	1224.0	1598.4
1929-34 inclusive	1858.0	2006.2	1258.0	1898.9	1916.9	1670.6	1027.9	1455.7

During 1936 fertilizer applications will be resumed at one-half the rate applied previous to 1935.—(C. D. Grinnells.)

Dairy Cattle Pasture Studies III—Mountain Branch Station.—The data on this study shows a good increase in production on the nitrogen plats. Due to the continued low yield on Plat IV (phosphoric acid + potash) it was deemed advisable to apply the basic applications to the check plat. The net yield expressed in total digestible nutrients per acre for 1935 is as follows:

	Plat 1	Plat 2	Plat 3	Plat 4	Plat 5
T. D. N. (net) Per acre for 1935	2378	2436	1800.0	1562.0	2203
T. D. N. (net) per acre (5 yrs. '30-'34)	2001.2	2009.2	1251.6	1160.9	1801.6

Fertilizer applications per acre for the above plats are as follows:

Superphosphate	300#	300#	300#	None	300#
Nitrate of soda	160	260	None	None	360
Muriate of potash	50	100	50	None	50

For the previous five years (1930-34) Plat IV received the same basic application that was placed on Plat III during the 1935 season.

The yields on Plat IV, or for the phosphoric acid potash applications, have not been in line with results obtained by other investigators using similar treatment, nor with a similar application at the Central Station. The subsoil in this plat is very shallow and rocky. It is also badly infested with larvae of Green June Beetle and ground moles which damage the roots of the perennial grasses. The bare areas grow up to crab grass and other undesirable species which give very little grazing.

Mr. George B. Lay, of the Bureau of Biological Survey, gives us the following opinion, "The mounds of earth are apparently upheaved by larvae of the Green June Beetle (Cotinis nitida L.)". These mounds were scattered over the plats infested with moles. The larvae were more numerous in the areas with large numbers of runways. Mr. Lay states that the larvae of Cotinis nitida L. have done and are continuing to do heavy damage to the pasture by uprooting the grasses on the areas involved. He believes these larvae are harmful to all grasses, but particularly to blue grass. The tunneling of the moles which live on the larvae adds to the damage caused by the larvae, and produces a marked detrimental effect.

The grass in many places has been uprooted so often as to result in destroying the blue grass, and the continued growth of crab and other less desirable varieties has reduced the value of the plat for pasturage.—(C. D. Grinnells.)

Dairy Cattle Pasture Studies III-a—Ashe County.—This is a study of pasture fertilization in Ashe County, an area which depends largely on pastures. The milking herd is rotated on the plats.

R. W. HARDIN PROJECT

2 Acre Plats	Plat I		Plat II		Plat III	
	Fertilizer per acre	T. D N. net yield	Fertilizer per acre	T. D. N. net yield	Fertilizer per acre	T. D. N. net yield
Nitrate of sida 16%	100#		0		100#	
Phosphoric acid 16%	200	3044	0	2104	200	3727
Muriate of potash 48%	33		0		33	
Nitrate of soda 16%					100	
T. D. N. yield per acre (net)		1522		1052		1863.5

J. E. McMILLAN PROJECT

2.37 Acre Plats	Plat I		Plat II		Plat III	
	Fertilizer	Yield	Fertilizer	Yield	Fertilizer	Yield
	Per Acre		Per Acre		Per Acre	
Nitrate of soda 16%	100#		0		100#	
Phosphoric acid 16%	200		0		200	
Muriate of potash 48%	33		0		33	
Nitrate of soda 16%		6671		4352	100	6380
T. D. N. yield per acre (net)		2814.7		1836.3		2691.9

G.. B. PRICE PROJECT

Fertilizer Distribution—3 Acre Plats			Net yield T. D. N.	Net yield per acre T. D. N.
Plat I	Phosphoric acid 16%	200#	.....	.....
	Lime	1000	1539	513.0
Plat II	Phosphoric acid 16%	200#	.....	.....
	Muriate of potash	33 1-3	.....	.....
	Lime	100 T	1604	534.6
Plat III	Check—no fertilizer—no lime		1592	530.6
Plat IV	Phosphoric acid 16%	200#	.....	.....
	Muriate of potash 48%	33 1-3	.....	.....
	Nitrate of soda 16%	100	.....	.....
	Lime	1000	2128	709.3
Plat V	Check—no fertilizer		.....	.....
	Lime	1000#	1580	526.6
Plat VI	Phosphoric acid	200#	748	249.3

(C. D. Grinnells.)

Lespedeza as Supplementary Pasture—Central Station.—Plats of three acres each were seeded with Tennessee 76, Korean, Common, and Kobe with the object of studying the value of lespedeza in building up submarginal land and at the same time furnishing enough supplemental grazing to pay the expense.

The supplementary grazing has paid the expense up to the season of 1935.

There was little need for supplementary grazing this year and it was thought best to allow the growth of a better plant cover. Each of the plats with the exception of the Kobe were given a top dressing of 220 pounds of phosphoric acid per acre on May 1.

Clippings were taken from each plat and compared with clippings from an unfertilized strip of the same variety. The fertilized plats produced a yield of one-fourth to one-third more than the unfertilized plats.

The fertilized areas also produced more seed and appeared to produce a more growthy, vigorous plant, indicating a stronger root system which is a factor where periods of drouth are common.—(C. D. Grinnells.)

Kudzu as a supplementary grazing crop.—The two acre plat of Kudzu made an excellent growth this year, and with the exception of a few small areas, the plat has a good uniform cover. It was used as a reserve pasture and allowed to build up good strong root systems supporting an excellent growth of vines. It was grazed during the late fall with two-year old heifers.

Nine heifers grazed steadily for twelve days, giving a total of one hundred and eight grazing days.

No supplementary feed was given during this period.—(C. D. Grinnells.)

The comparative value of peanut and soybean hay for milk production —Central Station.—The peanut acreage in 1933 was 2,093,000 acres which was valued at $35,000,000. North Carolina grows 100,000 acres. Peanut hay is a by-product of this industry. Some practical feeders report favorable results from using the hay, but its relative feeding value in comparison with other hays is unknown.

Two feeding trials have been completed comparing peanut and soybean hay of similar grades. These two hays compare favorably in total digestible nutrients. The two rations differed only in the kind of hay fed. In the first feeding trial the yield of milk and butterfat on the rations was very similar. The soybean hay ration required slightly more of all feeds per unit of production.

In the second feeding trial the peanut hay was slightly more efficient. When on peanut hay 24.89 pounds of milk was produced daily, while 22.81 pounds of milk was produced daily on soybean hay. The peanut hay ration showed a more marked advantage over the soybean hay ration in maintaining body weight. Each lot of cows made a gain in weight when fed the peanut hay. The peanut hay was of good quality and would grade better than the average peanut hay. We believe that a knowledge of the value of this by-product of the peanut industry will bring about a better system of caring for this hay.—(C. D. Grinnells.)

Cooperative survey of animal improvement in dairy cattle.—This survey of the improvement in dairy cattle was made in cooperation with the Bureau of Dairy Industry and the North Carolina Agricultural Extension Service.

The following table gives a summary of the data which has been reported to the Bureau of Dairy Industry.

Herd No.	No. Sires in Survey	No. Daughters in Survey	Daughter-Dam Comparisons	Number of Daughters					
				Exceeded Dams			Less Than Dams		
				Fat %	Milk	Fat	Fat %	Milk	Fat
1	9	150	131	92	58	65	39	73	66
2	12	92	68	38	31	34	30	37	34
3	5	69	51	24	24	23	27	27	28
4	5	39	34	22	17	22	12	17	12
5	4	32	22	8	14	12	14	8	10
6	8	57	41	29	27	28	22	24	23
7	3	50	34	28	15	20	6	19	14
8	3	73	68	40	47	53	28	21	15
9	3	24	21	7	12	12	14	9	0
10	36	551	513	228	251	242	285	262	271
Total	88	1137	983						

In addition to the above, seven herds were surveyed on which the data was insufficient to complete the requirements. That is, data on three sires having five daughter-dam comparisons each were not available. In some of these herds the lactations were incomplete on the third sire, and in a few herds the eradication of Bang's disease left too few daughters of a sire to meet the requirements.

Excellent cooperation was received from all the breeders.—(C. D. Grinnells.)

Herd improvement study—Coastal Plains Station.—In 1910 foundation animals were purchased for a Jersey herd at the Coastal Plains Station, at Willard, North Carolina. Production bred sires, as far as can be judged by pedigree, have been purchased to head this herd as they were needed. In all cases the prices paid have been in line with what could be paid by good dairymen. While some delay was experienced in the first eight years due to Bang's disease, considerable data have been accumulated indicating the progress that may be expected when this type of herd-sire management is employed. The table below gives the production data on the foundation herd and the daughters of each sire.

	Milk	Butterfat-Per cent	Butterfat-Pounds
Foundation Cows	7023	5.00	351
Eminent 19th's daughters	9428	5.18	489
Rumina's King's daughters	9901	5.21	517
The Distinguished Eminent	9058	5.57	505

The first sire Eminent 19th, 78620, produced 17 daughters that excelled their dams in butterfat percentage, 15 daughters that excelled their their dams in milk and butterfat production. His daughters produced 32% more milk and 35.9% more fat than their dams.

The second sire Rumina's King, 160969, produced 12 daughters that excelled their dams in butterfat percentage, 15 daughters that excelled their dams in milk production, and 18 daughters that excelled their dams in butterfat production. His daughters showed an increase of 7.5% in milk production, and 9.5% in butterfat production.

The third sire, The Distinguished Eminent, 222775, produced 11 daughters that excelled their dams in butterfat percentage, 6 daughters that excelled their dams in milk, and 9 daughters that excelled their dams in butterfat production. Seven percent of his daughters showed an increase over their dams in butterfat percentage, 9.7% of his daughters did not equal their dams in milk production, and 4.2% of his daughters did not equal their dams in butterfat produced.

The above data indicates what may be expected even when one is successful in choosing herd sires. As production increases it becomes more difficult to select herd sires that will transmit increased production, or even hold the high production attained. In other words, The Distinguished Eminent, 222775, had a more difficult assignment than the two previous herd sires. He held the production up to its previous position with but few exceptions.

In addition to transmission of an increased production or the maintenance of a relatively high production, a bull should sire progeny of good type. The Distinguished Eminent made a valuable contribution in the improvement in type of his progeny from dams descending from the two sires that preceded him.—(C. D. Grinnells.)

A comparison of alfalfa and lespedeza sericea hay.—Lespedeza sericea is adaptable to our climatic and soil conditions and there is considerable interest in it as a forage crop. Its lw lime requirement and its ability to withstand drouth are two cultural characteristics that favor it in competition with other legumes.

The livestock man must be satisfied in regard to its feeding value before he approves of it as a forage crop for livestock feeding purposes.

In order to determine its relative feeding value we are comparing it with alfalfa. In the first trial it did not appear to be as palatable as alfalfa, the animals fed the lespedeza sericea ration lost considerable weight, and the alfalfa ration produced 18.3 percent more milk and butter than the lespedeza sericea ration. These results are not sufficient as yet to justify us in drawing definite conclusions, and this work is being continued.—(C. D. Grinnells.)

Cooperative dairy-crop utilization.—This is a cooperative study by the Farm Management, Agronomy and Dairy Research sections. The data for 1935 show an increase in the cost of milk production of 1.65 cents per gallon, which is due to increased feed costs. The crop production costs are very similar to those of previous years. The yields and costs of production do not show a trend which would indicate a beneficial effect of the type of management practiced.—(C. D. Grinnells.)

POULTRY INVESTIGATIONS

Investigation of Septicemic diseases among fowls in North Carolina.—

(a) A study of the relative effects of mercurophen and of phenol when used as preservatives for avian typhoid bacterin on antibodies and possible anaphylactic shock produced.

Studies conducted during the second year of investigation bear out those of the first year, that mercurophen is much superior to phenol as a preservative for avian typhoid bacterins. Studies on normal agglutinins against avian typhoid in the blood of fowl indicated an increase of such bodies in the blood as the birds mature. Trapnest records on birds vaccinated with phenol preserved bacterin and with mercurophen preserved bacterins indicated a slight toxic effect in cases where phenol preserved bacterins were used and apparently no such reaction where mercurophen preserved bacterins were used.

(b) Laboratory studies of adult carriers of avian typhoid.—Studies were conducted on 15 naturally infected field cases of avian typhoid. Eight birds survived the disease and seven succumbed shortly after arrival at the laboratory. In these cases the fowl typhoid organism was present in the blood, faces and upper respiratory tract in the majority of instances. One bird carried S. gallinarum in its upper respiratory tract for nearly four months, during which time the bird appeared healthy and was in production.

Of several hundred eggs laid by survivors of natural infection, three were found to contain S. gallinarum.

(c) To measure the dissociation of certain strains of S. pullora brought about by laboratory transferring, and the relationship of agglutinability to types encountered.—Three strains of S. pullora, commonly used for antigens, were transferred at monthly intervals; one set being stored at room temperature, and the second set at refrigerator temperature (4-6° C.). At two-month intervals antigens were prepared and tested for sensitivity against known anti-pullorum sera. No definite variation in agglutinability was noted in studies conducted during the seven months elapsing from the beginning of the study to the present date. Colonial morphology to date has revealed no marked tendency toward variation. When daily transfers are made there is an apparent but slow trend of rough colonies to smooth, although the change is not marked in 160 daily transfers in broth and 75 transfers in agar.

(d) **Serological studies on adult carriers of pullorum disease.**—Studies completed and published in Technical Bulletin 48, April 1935, Agricultural Experiment Station of N. C. State College.—(R. S. Dearstyne, R. E. Greaves and H. C. Gauger.)

Normal and pathological metatology of the fowl; studies on the hematology of chicks and adults infected with S. pullora.—Studies completed and bulletin in hands of the Director of the Experiment Station at the present time.—F. W. Cook and R. S. Dearstyne.)

The influence of protein levels on the growth of pullets during the developing period.—(Work conducted at the State Test Farm at Willard, N. C., and at Swannanoa, N. C.).—The study as noted was completed for publication October 1, 1935. Single Comb White Leghorn pullets and Single Comb Rhode Island Red pullets in groups of 35 each were started at approximately 2 pounds weight, and carried through the developing period until 25 percent production was reached and maintained for seven consecutive days, on mashes containing 17.38 percent, 15.09 percent, and 13.43 percent protein approximately. Scratch feed was fed in addition to the mash and the birds allowed free range.

The following results attended these investigations:

1. The studies presented no definite difference in the development of body weight, time required to reach sexual maturity, or pullet year production on the group fed mashes of different protein level.

2. In general, the results of these experiments would indicate that the results obtained do not warrant the higher protein level of approximately 17.5 percent in developing mashes, and that this level during the developing period may be reduced to at least that of the second level under test, or approximately 15 percent, with the possibility of further reduction without creating a hazard to the future performance of the birds.—(R. S. Dearstyne, C. O. Bollinger, G. K. Jones, and H. P. Brigman.)

To study the factors entering into the successful production, fattening, and marketing of summer broilers. (Studies conducted at the State Test Farm, Swannanoa, N. C.).—The experiment completing its second year involved a study of the factors involved in production of summer broilers.

Five hatches numbering 1637 chicks, were started on test, the first group being hatched April 19, and the last group June 14. Ten days in the starter battery showed ranges in gain in ounces per chick from 0.82 to 1.31. Mash consumption per chick in this period ranged from 2.7 ounces to 3.3 ounces. There was noted a relative decrease in gain of weight in chicks in the starter battery as the season advanced. The groups of birds were placed on range from the time out of the starter battery until approximately 1.8 lbs. in weight was reached, at which time they were placed in fattening batteries. A direct decrease in gain per bird per day on range was noted in the respective hatches as the season advanced, this finding paralleling that of the previous year. Calculated days on range required for each hatch to obtain the same weight ran from 59 in the first hatch, to 74 in the fifth.

As in the first year of the experiment, an inverse amount of grain and of mash consumed on range existed between the first and fifth hatches, the first group consuming 3.1 pounds of grain and 2.4 pounds of mash per bird, and the fifth group 1.7 pounds of grain and 2.7 pounds of mash.

These fattening rations were used, two being home mixed, and one a commercial fattening mash. These rations were fed moistened with water in one group, and with milk in a second group. Fattening was carried out until a definite break in increase in weight was noted. In all cases the ration with a milk supplement gave the greatest gains at a slightly higher feed cost. The commercial fattening ration, which was of a complex nature, gave the highest rate of gain of the mixtures under test. The milk-fed broilers brought a premium of two cents per pound.—(R. S. Dearstyne and G. K. Jones.)

A Comparison of the value of a combined started and developer mash with the present North Carolina system of separate starting and developing mashes, for the efficient development of chicks to the laying age, and the relation of such systems of feeding to subsequent production. (Studies conducted at the State Test Farm at Willard, N. C., and at Central College Farm, Raleigh, N. C.).—The project was started during the spring of 1934 and has been in progress for 28 weeks. The test birds have had a mash available with an approximate protein level of 17.5 percent, and the control birds a mash with an approximate protein level of 21 percent for the first ten weeks, and thereafter a developing mash of approximately 17 5 percent protein level. Both groups were liberally fed on scratch feed. Body weights at the Willard plant show the test birds 0.4 lb. heavier with less grain consumption, but with a higher consumption of mash. At the Central Plant weights of both groups are approximately equal, the test birds showing slightly less consumption of both mash and grain. Production studies are in progress. Experiment genetically controlled.—(R. S. Dearstyne and C. O. Bollinger.)

Cost of Production studies.—Studies on cost of production at State Test Farms at Willard and Swannanoa, N. C., and at Central College Plant at Raleigh. With Single Comb Rhode Island Reds at Willard, N. C., the feed cost per dozen eggs for the past twelve months was $0.185; at Swannanoa with S. C. White Leghorns and S. C. Rhode Island Reds the feed cost for the past twelve months was $0.129; at Raleigh with S. C. White Leghorns, Barred Plymouth Rocks and S. C. Rhode Island Reds the cost for the past twelve months was $0.129.—(R. S. Dearstyne.)

PEACH INVESTIGATIONS

Severe local drought conditions prior to and during harvest seriously affected yields on all experimental plots of peaches during the 1935 season.

Varying times and rates of nitrate fertilization applied to Elberta peach trees failed to give significant differences in yield. On plots that received nitrate fertilization in two equal applications at different times, yields were slightly lower where none was applied in early spring as compared with each other or with checks.

Weather conditions during the late summer and fall of 1934 were satisfactory for growth, and development of reserves of carbohydrates. Although early spring applications of nitrate resulted in higher percentage amounts of reducing sugars, and lower percentage amounts of sucrose and starch at the end of the period of length growth in August 1934, little difference between treatments was found in carbohydrate materials in October. Approximately equal conditions of carbohydrate reserves were found in all treatments during the winter. Trees receiving later applications of nitrate had greater percentage amounts of total nitrogen.

In 1935 differential fertilizer treatments were started in a young Hiley orchard to determine the fertilizer requirements of peaches grown with legume and non-legume winter cover crops and with clean culture. Different amounts of 4-8-4 fertilizer have been applied under the cover crop and supplemented with nitrate applications in the spring. Measurements of yield and size of fruit and growth of cover crop and tree have been secured.

In general, best yields in 1935 were obtained on plots receiving heavier total annual amounts of nitrogen and heavier spring applications of nitrogen.

Light, heavy and medium pruning are being tried on single rows of 33 trees each. Heavy pruning as compared with light pruning reduced yields approximately 50%, and although it decreased the number of smaller size fruits, failed to increase the number of fruits 2¼" in diameter or over.

Experimental plots planned to test the value of manure in peach orchards with Golden Jubilee variety failed to set a satisfactory crop.—(C. F. Williams.)

Peach Leaf Area Studies.—To study the relation of leaf area and leaf efficiency to the development and quality of peach fruits and the growth of the peach tree.

General Conclusions: (a) Within limits an increase in relative leaf area per fruit favors an increase in size of fruit and an improved quality as determined by the flavor and as measured by the acid and sugar content of the fruit. (b) The development of fruit resulting from a given leaf area per fruit varies markedly with significant differences in soil moisture conditions.

Results of the past year: (a) Fruit size as influenced by thinning practices; first, influence of dates of thinning upon fruit size and quality, based upon studies utilizing the Hiley, Georgia Belle, and Elberta varieties, of portions of given trees thinned to commercial load at two week intervals over a period of from nine to three weeks from date of harvest. Date of thinning for 1934 season produced no significant differences in fruit size and fruit quality as determined by color and flavor. Second, influence of rates of thinning at given dates during fruit development, based upon studies of

whole trees thinned to different relative loads fourteen and six weeks before harvest—observation of Augbert variety only. This orchard was severely defoliated late in the season as a result of spray injury. Inasmuch as the injury was not uniform over the experiment plots it is questionable whether these results should receive consideration. (b) Fruit bud formation as influenced by dates of thinning—no significant differences for this particular season; the abnormally favorable growing conditions of this season were considered to be an important factor. (c) Fruit-pit dimensions as influenced by thinning practices—analysis of data incomplete at this date. (d) Soil moisture conditions. Soil moisture was not limited over any appreciable period of time during the fruit development season. It is considered that the abundance of moisture was mainly responsible for the lack of a more definite response resulting from the different fruit thinning treatments.—(Ivan D. Jones.)

Peach Fertilization.—This is the second bearing year for this orchard at the Piedmont Station. While no conclusions can be drawn, some significant differences are apparent.

From data received in 1935 the following observations are made:

1. There was practically no difference in total yield between treatments of unfertilized vetch cover crop plus nitrogen applied to the trees, and unfertilized vetch alone. These were the two highest yielding plats.

2. N-P-K applied to the tree under clean culture conditions ranked third in total yield.

3. Vetch cover top dressed with 200 pounds of a 4-12-4 fertilizer plus P-K applied to trees gave the highest percentage of desirable fruit grades.

Measurements were made on one hundred terminal branches from each plat and the number of fruit buds determined. No report is given at this time.—(M. E. Gardner.)

Studies on the control of bacteria spot of peach caused by Bacterium Pruni.—The bacterial spot of peach was of such minor importance during the year that conclusive results on the effectiveness of chemicals on the control of *Bacterium pruni* was not obtained. However, copper phosphate, ammonium copper silicate, red copper oxide, and copper zeolite were effective in controlling *Bacterium pruni* on the Hale variety on which from 23 to 35 percent of the fruit on untreated plots were diseased. Since these chemicals, especially copper phosphate and ammonium copper silicate were shown in field tests in 1934 to effectively reduce losses of fruit but not of leaves caused by *Bacterium pruni* an effort was made during the year to obtain greater sticking and more durable qualities of these materials on the foliage. Potash fish oil soap, and emulsified mineral oil, fused bentonite sulphur, and calcium caseinate were used in various combinations. All of these materials improved the sticking qualities of the mixtures, since the 4.30 to 6.40 inches of rain that fell during 18 days in July removed only slight amounts of the chemicals applied during July. The chemicals had persisted on the foliage in abundance as late as the first of October, since this was indicated by the uniform reddening of the leaves characteristic of copper injury developed well on the treated trees during that month. The most effective treatment resulted from the application of fused bentonite sulphur with the copper compounds. This combination of sulphur and bentonite contains the neces-

sary elements for a durable and satisfactory sticker. Combining the copper materials with the sulphur and other chemicals used for sticking purposes did not cause any symptom of injury. It was shown in tests conducted during 1934 that the inert copper materials when applied previous to the fifteenth of May caused severe leaf spotting, reddening of leaf and defoliation. Since no injury occurred after that date, or after the mean temperature was near 75° F., the treatments were given in 1935 after the mean of 75° F. was reached. As was the result in 1934, there was no injury during June, July and August, but reddening of the leaves developed during October. Since the *Bacterium pruni* infections are rarely severe previous to the first of June, the results with the inert copper compounds appear to have practical significance.

One and two pounds of the copper materials were mixed with 5 pounds of chemical hydrated lime in 50 gallons of water. One pound of potash fish oil soap, or 3 pounds of fused bentonite sulphur, or ½ pound of calcium caseinate, or one pound of emulsified mineral oil was used in the above mixture. Before this treatment can be recommended for practical application it is advisable to test both smaller and larger dosages on foliage and the organism. The copper oxide material, prepared by combining lye, molasses and copper sulphate resulted in severe spotting of leaf, fruit, and twig, and before the ripening dates, the trees had nearly defoliated and had also dropped most of the fruit. The nature of injury was a prominently dehydrated circular spot with a distinct reddening over the surface of the leaf. The fruit was most prominently injured on the sun exposed surface. The tissues of the fruit turned black sometimes throughout the fleshy part. The tissues of the new twigs developed dehydrated spots and the prominent reddening similar to that seen on the leaves.—(R. F. Poole.)

Results of further studies on the control of arsenical injury on peach.—After studying arsenical injury on the peach for several years it was observed that the injury was worse in wet seasons and most severe during wet periods following drought periods. Studies on the control of arsenical injury during the past few years have shown that zinc sulphate when used with arsenate of lead and lime had reduced materially the arsenical injury. For three years it was apparent from these studies that when three pounds of zinc sulphate was used with all arsenate of lead applications in 50 gallons of spray that arsenical injury was so greatly reduced that neither leaf, bud, nor fruit was damaged as severely as they had been when zinc sulphate was omitted from any of the three sprays. It was significant that the continuous annual defoliation, bud destruction, and cankers in the crotches resulted in permanent injuries to the tree; and the control of these factors was so well demonstrated in the earlier tests that growers began immediately to apply zinc sulphate with all arsenical sprays.

Five years after the first favorable results were obtained by adding zinc sulphate to the arsenate of lead and lime combination, the control effectiveness of the chemical remained significant on leaf, bud and twig. Reduction of injury on fruit has been significant also, but not sufficient to meet the needs of the grower. During the 1935 season it was shown that the amount and distribution of the rainfall during May, June and July was a determining factor in bringing about the serious fruit injury. These conditions were so well marked during the 1935 season that it seems pertinent at this time

to give you a brief discussion of the relations of low rainfall during May and June, and high and constant rainfall during July to the development of fruit injury, since the data adds further value to that presented in Technical Bulletin Number 49.

Previous to June 15, arsenate of lead is applied in commercial peach orchards at petal fall, shuck fall, and again before June 30, with a fungicidal spray.

In practice an attempt is made to time these sprays so that the last application will precede by one month the harvest period of July 5 to 10 for Hiley Belles, July 10 to 20, for Georgia Belles, and July 15 to 30 for Elbertas. The exact time that these sprays are applied varies with seasonal effects, since there is neither uniformity of blooming, petal fall, nor shuck fall, and inclement weather, especially sand storms, often causes a delay of several days in applying spray materials. However, the arsenate of lead applications are for petal fall, May 5; shuck fall, May 15, and again on June 15. The spray equipment used in the commercial orchards is modern in every respect. This assured desirable mixing, agitation and coverage. During the 1935 season all three sprays containing arsenate of lead were applied during drought conditions. The rainfall during May was only 3.15 inches. This small amount fell on May 15 to 17, 19 to 22 and 24. During June 1 52 inches of the total rainfall of 1.99 inches occurred on the 3rd and 4th. The rainfall for June is the lowest on record in a period of 48 years. The month was slightly warmer than usual, with a high percentage of sunshine. The arsenical injury observed during this period was inconspicuous even where zinc sulphate was not applied with the arsenate of lead. Leaf injury during this period was the least seen in eight years. The low rainfall during this period did not cause unfavorable growth of new wood and foliage development. It was apparent that all of these characters were better developed than usual. The fruit was abundant and developed rapidly during this period, but failed toward the end of this period to reach satisfactory sizes. The foliage also began to lose much of its green color, but the amount of defoliation was the smallest observed in eight years. Growers estimated that it would have been an ideal season for the development of the crop if sufficient rain had fallen during the middle of June. No attempt was made to determine the effects of the drought on the metabolism of the fruit, but it was evident that certain changes were apparent. The bronzing sometimes spoken of as sun scald was more conspicuous than usual. However, despite the fact that it was reduced in size there was apparently no pronounced change in the edible qualities of the fruit.

The protracted period of sunshine and dry conditions ended on July 1. Cloudiness throughout the month of July was considerable. One-half of the month was partly cloudy to cloudy. Rainfall occurred on 18 days and was uniformly distributed throughout the month. However, the local showers during July were heavier in certain localities than in others. The rainfall on one farm where experimental tests were conducted was 6.40 inches as compared with an average of 4.31 inches for the Rockingham, Pinehurst, and Southern Pines stations, which are strategically located on borders of the sandhill peach area.

These conditions resulted in the greatest arsenical injury seen on fruit in 8 years. The fruit began to color well in advance of the ripening period; however, there was no conspicuous evidence of arsenical injury until the

fruit began to ripen. As the fruit ripened the reddening increased on the sun exposed surface with such rapidity that much of it was rendered unsatisfactory for shipping in a short period of a few days. This was observed on Hiley Belles, Georgia Belles, and Elbertas, which ripened at intervals of 10 days, respectively.

Under the prevailing conditions of the 1935 season, zinc sulphate reduced arsenical injury on fruit only slightly. It was not a satisfactory reduction. The ammonium copper silicate, red copper oxide, and copper phosphate used at the rates of 4 pounds with 6 pounds of fused bentonite sulphur, 10 pounds of lime and one pound of arsenate of lead in 100 gallons of water, prevented arsenical injury more satisfactorily than did zinc sulphate. Under the conditions prevailing this season the injury was not important where the arsenate of lead was omitted from the June 15 spray. It did not develop on fruit sprayed with 3 pounds of basic lead arsenate in 100 gallons of water.

It is significant that the leaves and buds were not injured at any time during the year and the trees retained more foliage throughout the season than is usual. The results of these studies indicate that a method of determining the amounts of arsenate of lead on the fruit should be devised, since in dry periods excessive amounts of arsenate of lead could be avoided. On the basis of the present knowledge it may seem advisable to use basic arsenate of lead or reduced amounts of arsenate of lead during drought seasons in the last application, which is given about four weeks previous to harvest, and to use zinc sulphate with all earlier cover sprays containing arsenate of lead.—(R. F. Poole.)

SMALL FRUIT INVESTIGATIONS

Raleigh, Statesville, Sandhills Calypso

Raspberry fertilization.—Plants fruited for the first time in 1935. Harvesting began June 12 and continued through July 1. While no significance is attached to yields the first year, it is interesting to note that the difference between the yield of berries harvested from the highest and lowest plats was 667 pints per acre.

In addition to yield data, leaf counts were made, and number, length and circumference of canes recorded. In connection with leaf counts, comparison was made between sprayed and unsprayed plants.

Disease caused rather severe defoliation. It is believed, however, that by adding one or two more bordeaux sprays to the schedule fungus diseases may be largely controlled.

Two red seedlings, U. S. D. A. No. 9 and N. C. R-30, planted at Statesville in March, 1935, showed greater resistance to foliage diseases than Latham.—(M. E. Gardner.)

Strawberry fertilizer project.—To study the effect of cultural practices and fertilizers on the yield, size, and quality of strawberries.

A series of fifteen plots in triplicate was laid out in the spring of 1934, yielding the first crop in 1935. Fertilizer applications were made in June, September, and December, or combinations of those dates. A standard mixed fertilizer, nitrate of soda, and various organic materials were applied alone or in combination. Cyanamid was used on one plot. For the first crop season those plots receiving organic fertilizer such as fish meal, cottonseed

meal, and Peruvian guano, and those plots receiving greater amounts of nitrogen gave the highest yields.—(Robt. Schmidt.)

Dewberry investigations.—Fertilizer plots with Lucretia dewberries to study the time of application were started after harvest in 1934. A complete fertilizer (4-8-6) was applied at the rate of 600 lbs. per acre about July 1 after the plants had been pruned off. This was supplemented either with 400 pounds per acre of nitrate about September 1 at the last cultivation before vine growth stopped cultural operations, or 300 pounds nitrate September 1, and 100 pounds in March after canes were tied up. These treatments were compared with the more usual practice of applying the complete fertilizer in early spring, supplemented with nitrate July 1 after pruning. Identical amounts were used. In 1935 summer and fall fertilization averaged six canes per hill, as compared with 5 for the check. Yields were 8% and 12% greater than the check.—(C. F. Williams.)

Raspberry Breeding.—Breeding for a disease resistant red raspberry adapted to the southeast is being continued. Some seedlings of a R. biflorus x Chief cross have been selected as showing promise. Hybrid R 30 is being tested in several locations. The past season it has been subject to leaf spots, but although it suffered 15% defoliation, Latham under the same conditions was 70% defoliated.—(C. F. Williams.)

Dewberry.—Dewberry seedling D 2 has been productive in the sandhills and is being propagated. This seedling averaged 21 canes per hill, as compared with 5 per hill for Lucretia of the same age and under identical conditions. Some new seedlings of Young x Lucretia have been selected for disease resistance, productivity, quality, and reduction of thorniness.—(C. F. Williams.)

Experiments in Cooperation with the Office of Soil Fertility Investigations of the Federal Bureau of Plant Industry

A study of soil conditions unfavorable to strawberry production.—Strawberry growers of eastern North Carolina have within the last few years suffered great loss in returns from marketable berries. This loss has been due largely to three factors, (1) dying of strawberry plants during the summer; (2) poor shipping qualities of berries produced; and (3) low yields per acre.

These investigations, started in 1929, consist of experiments with fertilizer analysis or ratio of nitrogen, phosphoric acid and potash; sources of potash and nitrogen; rate of application of fertilizer; time of application and placement of fertilizer; acid and neutral fertilizers; lime; minor plant nutrients; and rotations.

The results of these investigations have been reported in Agronomy Information Circulars of the Experiment Station, Nos. 64 (1931), 75 (1933), 82 (1933), and 83 (1933). A paper, "The Relation of Fertilizer and Soil Reaction to Viability and Production of Strawberries," was presented before the Agronomy Section of the Association of Southern Agronomy Workers in 1935, and published in *Commercial Fertilizer*, April, 1935. Another paper, "The Effect of Nitrogen Fertilizers on Strawberry Production," was presented before the North Carolina Academy of Science in May, 1935, and published in the *Commercial Fertilizer*, August, 1935.

The change of strawberry growers from the use of neutral fertilizers, manufactured primarily with organic ammoniates, to acid-forming fertilizers, manufactured with increasing amounts of ammonia and its salts, has been associated with decreased viability of strawberry plants. The soils used for strawberry production around Chadbourn vary in acidity from pH 3.85 to 6.8, most of them being from 5.0 to 5.5. Laboratory and field data secured seem to indicate that the optimum pH for strawberries is about pH 6.0 and that the plants die where the pH is 4.5 or lower. It appears that there is a close correlation between the soil acidity and the dying of strawberry plants in the summer months. The use of lime and physiologically alkaline fertilizers would seem to be advisable.

In this connection, a series of experiments was started on new land near Chadbourn to determine further the effect of acid, neutral and alkaline fertilizers on strawberry production. One year's yield records show that the largest yield was obtained from ammophos and urea when made neutral with dolomitic limestone, and in all cases the yield was increased when the fertilizer was made neutral, the pH of the soil being about 5.0. A limestone experiment is also in progress using a 5-8-6 fertilizer. Lime was placed in the furrows before the plants were set in amounts of 200, 400, 600, and 800 pounds per acre. The largest yield was obtained where 800 pounds was placed in the furrow. Limestone was also broadcast in amounts of 600, 1300, 1800, and 2400 pounds per acre. The largest yield in this experiment was obtained where 1800 pounds of lime was used.

In another section of the field a fertilizer ratio experiment is in progress. One section had had a ton of lime applied before the plants were set, and the other section none. One year's experiments show that lime increased the yields in nearly every case, and also on the plots where no fertilizer was applied.

Considerable work has been done and is still in progress on the effect of nitrogen fertilizer on strawberry production. It may be pointed out that nitrogen is the principal fertilizer element influencing strawberry production. The results obtained thus far may be summarized as follows: Sources of nitrogen such as sodium nitrate increase the pH of the soil, while ammonium sulphate decreases it, the largest loss of plants usually taking place where the nitrogen in the fertilizer is derived from acid sources. Experiments indicate that nitrogen should be derived partly from organic and partly from inorganic sources. The largest yield for Norfolk fine sandy loam was obtained where 80 percent of the nitrogen was derived from sodium nitrate and 20 percent from cottonseed meal, and in the ammonia series the ratio was 50-50 on the Coxville sandy loam. However, on both types of soil the largest yield was obtained where nitrogen was derived 50 percent from ammonium sulphate and 50 percent from cottonseed meal. Spring applications of quickly available nitrogen increased the yield of berries, but delayed the ripening and greatly decreased the carrying qualities, heavy applications making strawberries unfit for shipping purposes, especially for long distances.

In the three-year nitrogen ratio experiment with a grower, the largest average yield was obtained when the nitrogen was derived 80 percent from ammonium sulphate and 20 percent from cottonseed meal. The pH of this soil, however, was a little higher than the average, it being pH 5.6. The lowest yield was obtained when the nitrogen was derived all from sodium

nitrate. The largest yield was obtained when all the nitrogen was derived from fish scrap.

In a three-year experiment with a grower results obtained seemed to indicate the placing of the fertilizer in the furrow six inches deep and six inches from the plats is more effective than was broadcasting the fertilizer on the row and middle.

One year's experiment on plats at the laboratory would seem to indicate that potassium sulphate is a little more effective than other sources of potash used.

In rare element experiments results thus far secured seem to indicate that the use of manganese favorably influences strawberry production. The use of copper too, on the soil which is not too acid in reaction seems to be beneficial.

On new land superphosphate greatly influenced vigorous plant growth.

In crop rotation experiments the greatest loss of plants occurred where the strawberries followed corn and soybeans, and the most vigorous plants were those which followed sweet potatoes in the rotation.—(Cooperation Bureau of Plant Industry; J. J. Skinner, R. A. Lineberry, H. B. Mann, and C. B. Williams.)

SWEET AND IRISH POTATO

Fertilization and Improvement

Fertilizer Experiments comparing acid and alkaline fertilizers for the production of sweet and Irish potatoes.—These experiments were started in 1935 with sweet potatoes on two fields, one of Norfolk loamy fine sand and one of Norfolk fine sandy in Currituck County; and with Irish potatoes on Bladen fine sandy loam and Portsmouth fine sandy loam in Beaufort and Carteret counties. Since these experiments were put out this spring no results are as yet available.—(Cooperation Bureau of Plant Industry; J. J. Skinner and H. B. Mann.)

Further studies on the control of sweet potato diseases.—In pot cultures where the soil was inoculated with *Fusarium batatatis* in 1931 and 1932, there was much less loss of plants on clay soils in 1934 and again in 1935 than on sandy soils, indicating that there is some soil factor possibly biological in character, that is inhibitory to this parasitic Fusarium in clay soils. Continuous cropping of sweet potatoes on infected soils in the field after 5 years showed that *Fusarium batatatis* apparently increases in abundance each year as measured by the severity of losses. In this work and over this period of testing on infected soils a strain of White Jersey with no seed stock infection in the beginning has become so severely infected that less than one-tenth of the seed stock available is healthy. However, in an adjacent plot which was not inoculated healthy seed stock has been produced continuously over this period of years. The results of this test clearly show the importance and advisability of using healthy seed stock and also good reasons why growers should protect the better sweet potato lands from infections of parasitic fungi.

Further studies on the control of black rot indicate that climatological conditions greatly influence the prevalence of the disease. In an acre planting where plants were heavily inoculated at the time of transplanting as had been done also in the two previous seasons, there was much less stem and

potato infection than was observed in the two previous seasons on the same soil. While these tests do not indicate the length of time that *Ceratostomella fimbriata* will live in the soil, they do indicate that losses will be widely variable even when diseased plants are used. Although growers seem to associate the severe losses caused by black rot with early plantings, the data obtained in tests conducted in 1934 and repeated in 1935 in which inoculated plants were transplanted in April, immediately after the danger of frost and at regular intervals of ten days thereafter to the tenth of August, do not support this theory. In fact, the loss of plants so far are heavier when plants are transplanted during July or after the major plantings have been made.

During the 1933 and 1934 seasons potatoes grown on plants inoculated with *Ceratostomella fimbriata* rotted severely in storage, although potatoes showing symptoms of disease at the time of storage were removed from the containers. Losses ranged from 30 to 100 percent. The losses in the 1935 crop range from 10 to 30 percent, although the potatoes of the same variety were grown on the same soil over the same period of time and on plants treated in a similar manner.

The drought conditions of May and June seriously interfered with studies on plant treatments, however, some interesting results were obtained with mercuric chloride on plant and soil treatment. Where the roots of sweet potato plants were dipped into mercuric chloride in strengths of one ounce in eight gallons of water, and in dilutions of this chemical up to one-tenth of this amount severe injury followed. However, when any of these strengths were poured into holes in newly prepared ridges at the same time the plant was placd in the hole there was no injury produced. While the practical values of these strengths in the control of the fungi were revealed, it is advisable to carry out further experimental tests with this chemical under a variety of conditions and especially under conditions that are more favorable for the development of *Ceratostomella fimbriata*.—(R. F. Poole.)

Irish potato breeding.—Approximately seven thousand seedlings were grown this year from seed of the following parentage:

Source	*Parentage*	*Purpose*
Presque Isle	S. 46243 x S. 45075	Earliness
" "	Russet Rural x S. 44537	Scab resistance
" "	S. 46499 x S. 45075	Earliness
" "	S. 46019 x S. 46422	Yield
" "	164-6 x 164-7	Yield
" "	S. 45208 x 164-6	Yield, etc.
" "	S. 45208 x S. 45146	Yield, quality
" "	Jersey Red Skin x Katahdin	Yield
" "	Paisley's Seedlings No. 3 x S. 45075	Earliness
" "	S. 45208 x S. 46422	Yield
" "	S. 45208 x S. 44537	Scab resistance
" "	Jersey Red Skin x S. 44516	Yield
" "	S. 46152 x S. 46197	Yield
" "	S. 45075 Inbred	Earliness
" "	S. 43752 x Katahdin	Yield
" "	Irish Cobbler (late) x S. 45075	Earliness
" "	S. 44763 x Katahdin	Yield
" "	S. 45132 Inbred	Yield, fertility
" "	S. 45217 Inbred	Yield, fertility
" "	Rural New Yorker x Katahdin	Yield
" "	Triumph x S. 24642	Earliness

Seed of the following crosses received from Presque Isle in 1930, were also included: White Ohio x S. 43055, S. 42672 x S. 42667, Early Rose x S. 43055, Early Rose x S. 42667, Irish Cobbler x S. 24642, Irish Cobbler x S. 43055, Green Mountain x S. 42667, Rural New Yorker x S. 42667, Garnet Chile x S. 24642. This seed lot was grown in pots in the greenhouse in 1931, but lost in the field due to poor germination.

The seedlings were harvested in August and stored. Selections will be made during the winter.

Jefferson.—Five hundred single tuber selections from seedlings grown in 1934 were grown for increase. Of this number seventy-six were saved for further increase and test. Thirty-three selections were grown in ten-hill sections, and thirty-seven in twenty-hill sections for further increase and observation. Those showing disease resistance and desirable tuber and vine characteristics will be added to the yield tests in 1936. A number of early selections were made from these groups and will be tested in the early potato section in 1936.

A mild epidemic of P. infestans occurred this year for the first time in a five year period. This gave an opportunity to obtain a reading on the susceptibility or resistance of seedings to this disease under field conditions.

Seasonal conditions were favorable in general. It is believed, however, that more moisture toward the end of the growing season would have increased yields somewhat.

Forty-three seedlings and named varieties were included in the yield tests. Of this number seventeen were discarded and twenty-six saved for further tests.

Attention is again directed to the performance of S. 130.5-24. It was reported last year that of all seedlings and named varieties tested, this selection was exceeded only by Golden in total yield. This year it has outyielded all material tested as will be seen from the table. The tubers are smooth, shallow-eyed and slightly russeted. It appears that this seedling is blight resistant as no evidence of the disease was observed, although other selections and varieties were attacked. Flea beetle and hopper injury was light.

It is planned to distribute seed stock of this seedling to cooperating states for further tests.

The splendid cooperation of Mr. W. L. Dent, on whose farm the work was conducted, is acknowledged.

Calypso.—Eleven early selections were tested in the eastern or early potato section in comparison with Cobbler and Triumph. The performance of four of the most promising are given in Table II.

All of the seedlings in this test are superior to Cobbler from the Standpoint of tuber characters. This test will be repeated in 1936, and other desirable early selections added.

In 1936 work will be begun looking to the development of a variety which will be adapted to the sandhills region. This region is characterized by soils of sandy, porous, open structure which are deficient in organic matter and subject to drought. It is planned to plant a number of progenies in four to ten hill units for a preliminary reading. (M. E. Gardner and Robt. Schmidt)

*TABLE I.—YIELD TESTS, JEFFERSON

Soil Type, Talladega Stony Loam. Fertilizer, 800 Lbs. 5-7-5.
Elevation, 3000 feet.

Seedling or Variety	Maturity	Bushels per Acre				Percent Grade		
		No. 1	No. 2	Culls	Total	No. 1	No. 2	Culls
Katahdin	M-L	205.3	30.3	2.9	238.5	86.0	12.7	1.2
130.5-24	L	319.6	65.3	15.1	400.0	80.0	16.3	3.7
Cobbler	E	81.7	74.7	36.1	192.5	42.4	38.8	18.7
44810	E	107.3	50.1	11.3	168.7	63.6	29.6	6.6
132.3-4	M	105.0	94.5	25.6	225.1	47.6	41.9	11.3
45656	M	163.3	42.7	9.3	215.3	75.8	19.8	4.3
44835	M	130.7	22.1	4.6	157.4	83.0	14.0	2.9
Golden	M	154.0	101.5	50.1	305.6	50.3	33.2	16.3
130.4-37	M	100.3	141.1	53.7	295.1	33.9	47.8	18.1
130-.2-28	E	91.0	98.0	28.0	217.0	41.9	45.1	12.9
133.19-2	L	186.8	60.7	16.3	263.8	70.8	23.0	6.1
44848	L	211.1	33.8	12.8	257.7	81.9	13.1	4.9
133.13-6	M-L	126.0	73.5	15.1	214.6	58.7	34.2	7.0
130.1-55	E	116.1	55.7	25.6	197.4	58.8	28.2	12.9
Chippewa	M	226.3	54.8	17.5	298.6	75.7	18.3	5.8
130.6-38	L	210.0	39.7	9.3	259.0	81.0	15.3	3.5
44926	L	204.1	29.3	5.8	239.2	85.3	12.2	2.4
44639	M	170.3	98.0	33.8	302.1	56.3	32.4	11.1
44584	L	177.3	18.7	4.6	200.6	88.3	9.3	2.2
133.13-2	L	231.0	50.2	12.8	294.0	78.5	17.0	4.3
230.62-1	M-L	183.2	128.3	36.1	347.6	52.7	36.9	10.3
132.3-2	M	119.0	100.3	30.3	249.6	47.6	40.1	12.1
130.6-27	L	305.7	54.8	9.3	369.8	82.6	14.8	2.5
130.6-23	L	320.8	26.8	5.8	353.4	90.7	7.5	1.6
44941	M	177.3	46.6	8.1	232.0	76.4	20.0	3.4
46110	L	260.2	64.2	14.0	338.4	76.8	18.9	4.1

*Replicated thirty-five hill sections were used in the test.

TABLE II.—YIELD TEST, CALYPSO.

Seedling or Variety	Bushels per Acre			Total
	1	2	Culls	
130.2-28	173.8	62.3	43.8	279.9
130.3-4	238.	40.8	24.5	303.3
130.4-37	191.3	75.8	35.	301.8
132.4-1	113.2	93.3	54.3	260.8
Triumph	149.3	65.9	20.4	235.6
Cobbler	125.4	67.7	56.6	249.7

Soil Type—Portsmouth Sandy Loam.

Marketing of North Carolina Fruits and vegetables by motor trucks.—This project was begun July 1, 1934. The general objective was to obtain information regarding the movement of fruits and vegetables by motor truck throughout the eastern United States. It is a joint project carried on in cooperation with the Farm Credit Administration. More particularly the objectives are as follows:

1. To obtain data which will enable cooperatives to determine a more effective use of motor trucks in marketing of fruits and vegetables.

2. To ascertain how truckers and dealers are meeting the problems which have arisen in the transportation of fruits and vegetables by motor trucks.

3. To develop a basis for controlling the volume of produce moving by motor trucks from shipping point areas to terminal markets.

4. To determine what additional terminal facilities or changes in such facilities are needed to handle more effectively the rapidly increasing volume of fruits and vegetables arriving by motor truck transportation.

5. To assist in estimating the probable volume of fruits and vegetables by motor truck at important terminal markets.

6. To encourage the development on the part of cooperatives' bargaining power so as to enable them to more effectively compete with the concentrated buying power in the large markets.

7. To determine the place of motor truck transportation in the national transportation scheme.

The information was obtained directly from farmers and truckers in North Carolina and from local farmers and truckers in northern areas. The information collected has been referred to the Farm Credit Administration for tabulation and analysis. This work is under the leadership of Dr. M. P. Rasmussen, of Cornell University.

Approximately 3500 grower records were obtained, of which 370 were from North Carolina, and 400 commercial truck dealers, of which 165 were located in this state.

The analysis has been completed for a number of the states. It appears that an increasing proportion of the perishable crops is being shipped by trucks. Farmers in North Carolina shipping string beans, cucumbers, strawberries and peaches to New York receive as great or greater net returns per shipment by truck as by rail. It appears, however, that lettuce shipped by rail brought greater net returns than shipped by trucks.

The following reasons were given by a number of growers for favoring truck shipments: (1) More prompt delivery, (2) more convenient, (3) less handling, and (4) cheaper. The truck is used largely for short hauls rather than long hauls. Less than one percent of the shipments from Florida and Georgia goes by trucks. The study shows that growers generally do not haul in excess of 100 miles. Hired trucks, however, may haul for longer distances.

The truck has apparently created two new problems in marketing. The first problem relates to information regarding supplies going on the market, and the second to terminal facilities. The shift from truck to rail has made it virtually impossible to estimate the daily supplies of

produce at any large market before trading begins. Terminal facilities for truck shipments are inadequate and this investigation reveals that new terminals should be erected in close proximity to the terminal facilities used by other types of carriers. (G. W. Forster and R. E. L. Greene)

PICKLE INVESTIGATIONS

Cucumber pickles.—To study some factors influencing the commercial manufacture of cucumber pickles.

Observations and results of the past year: (a) Acidity of brines at progressive dates during process and storage of salt stock. First—For all brine concentrations greatest acidity was developed by smallest sizes and least by largest sizes. Second—For a given size, the greatest acidity was developed in the brines of lowest salt concentration and the lowest acidity in brines of highest salt content. Third—Acidity of brines of intermediate salt concentration fell rather generally in order between the extremes given above. Fourth—Loss of acidity during curing season and subsequent storage occurred at a relatively slow rate. (b) Reaction or pH of brines at progressive dates during the curing and storage of salt stock. Colorimetric methods used were not satisfactory for a study of brines of different salt concentration. (c) Rate of curing of cucumbers—in general, smaller sizes cured more rapidly. Also most rapid rate of curing occurred in brines of low initial salt concentration. (d) Keeping Quality of Salt Stock—No appreciable difficulty was experienced in keeping the salt stock over a period of nine months after it was cured. The limited amount of spoilage which was encountered was, it is believed, associated only indirectly with the salting program. (Ivan D. Jones)

INVESTIGATIONS IN FLORICULTURE

Tests of new and standard flowering plants.—The object of this project is to study the adaptability of various ornamental plants to the environmental conditions under which they are grown.

Herbaceous perennial test.—Fifty-five species of herbaceous perennials have been tested during the past year; of these the following produced satisfactory results:

Archillea tengelifolium, Amsonia tabernae montana, Archillea tomentosa, Archillea Perry's White, Archillea millefolium roseum, Archilles filipendula, Cheiranthus allioni, Cerastium biebersteinii, Chrysanthemum mawii, Callirhoe involuorara, Dianthus granticus, Erysimum murale, Platycodon mariesii, Prunella grandiflora, Statice dumosa, Statice latifolia, and Scutellaria coelestina. (G. O. Randall and J. G. Weaver)

Iris test.—Twenty-nine varieties of iris have been added to our collection. Careful notes will be kept on their behavior during the next three years. Of the twenty-nine varieties twenty-four belong to the comparatively new group of irises known as Autumn Flowering.

Chrysanthemum test.—Fifteen varieties were tested out of doors during the past year for the purpose of determining which of these non-hardy varieties were best suited to culture out of doors. Of these the following seem to be best: Golden Glow Improved, Sunglow, Golden Herald, Mrs.

H. E. Kidder, Pink Delight, Charles W. Johnson, Lustre, Wolf's Pink, and Rose Marie. (G. O. Randall and J. G. Weaver)

Greenhouse Trials and Experiments

Rose test.—For a number of years a rose variety test has been under way for the purpose of comparing some of the newest with some of the older standard varieties of greenhouse roses. During the past year the following twelve varieties were included in the test: Senior, Souvenir, Token, Sterling, Mary Hart, Better Times, Roosevelt, Yellow Joanna Hill, Talisman, Talisman (in ground bed) Sunkist, Sunkist (in ground bed), Killarney, Killarney (in ground bed), Briarcliff, and Briarcliff (in ground bed). All of these produced quite satisfactorily, but some varieties were much better than others. The five varieties producing the largest yield per plant were:

Talisman	26.33 (in ground beds)
Roosevelt	24.25
Talisman	21.13
Mary Hart	19.40
Token	18.80

All of the varieties with the exception of those indicated, were grown on the bench.

All varieties were quite resistant to disease with the exception of Sterling, Sunkist, Mary Hart and Roosevelt. Mary Hart, Roosevelt and Sterling showed susceptibility to mildew, and Sunkist seemed to be susceptibile to black spot. (G. O. Randall and J. G. Weaver)

Carnation test.—The carnation variety test was continued as in past years for the purpose of testing the newest varieties with some of the older standard varieties. The following seventen varieties were included in the test: Patrician, My Love, Satellite, Ocean Spray, Bonanza, Lucky Strike, Legion, Vivian, Mina Brenner, Joan Marie, Scarlet Monarch, Chief Kokoma, Luminosa, Mary Sim, Light Pink Abundance, Lindy Lou, and Hilda. Of these the following produced the highest average yield per plant:

*Legion	18.75
My Love	17.04
Mary Sim	13.86
Satellite	13.75
Vivian	13.63

My Love, Lucky Strike, Bonanza, Luminosa and Legion seemed to be more susceptible to disease than the other varieties in the test. My Love showed especial susceptibility to rust, and Legion to stem rot. (G. O. Randal and J. G. Weaver)

Carnation breeding.—During the spring of 1933 several crosses were made between a number of standard varieties of carnations with the thought in mind that it might be possible to develop varieties especially well suited to the climatic conditions in North Carolina. Approximately 150 seedling plants were grown from these crosses. Out of this number five were selected for further trial and were propagated in large enough

*Eight plants died soon after they were set, which gave more space to those remaining, and which may have had some effect on the yield per plant.

quantities so that they might be planted in the test during the fall of 1935. Careful records are being kept on yield and disease resistance this year. During the 1934 season eighteen more crosses were made, in which sixteen varieties were used. Three hundred and thirty-six seedling plants from these crosses are being grown this season. (G. O. Randall and J. G. Weaver)

Chrysanthemum test.—Fifty varieties of chrysanthemums were included in the greenhouse variety tests during 1935. Of these the following were most satisfactory: Camilla, Citronella, Rose Marie, Yellow Monument, Good News, Betsey Ross, Friendly Rival, Monument, Yellow Mistletoe, White Mistletoe, Dr. Enguehard, Eileen Masson, Beautiful Lady, Pomona, Gold Coin, Norman, Lanona, Susanne Miller, Valencia, Princeton, Garza Supreme, Garza, Dainty Maid, Little Tot, Mary Pickford, Golden Fringe, Yellow New York, Margaret Clark, Yellow Doty, Lida Thomas, Rose Charm, White Mensa, Muskoka, Elizabeth Firestone, and Christmas Gold. (G. O. Randall and J. G. Weaver)

The propagation of floral plants.—The object of this project is to determine the best location on the plant from which to take cuttings and the best medium, temperature, and time for rooting them.

There is quite a lot of variation of the methods followed commercially in the taking of leaf-cuttings from Melior Begonias. Most commonly the larger leaves are used as cuttings, the whole leaf constituting the single cutting. It was thought in starting this experiment that leaves taken from different locations on the plant might respond differently with reference to length of time required for rooting and in percentage of rooting.

Whole-leaf cuttings were made using the small top leaves. In comparison with these, whole-leaf cuttings were made using the larger average-sized leaves toward the lower part of the plant. The rooting medium of pure sand was kept at a temperature of 75° F. The atmospheric temperature varied from 50° to 65° F. The cuttings were made and inserted in the medium December 10, 1934, and the records taken January 21, 1935.

It is not considered advisable to draw conclusions from the results of one year of work, but the data indicate that the small top leaves will root much more satisfactorily than the large leaves. Ninety-eight percent of the small leaves rooted, as compared with eight percent of the large leaves.

Another experiment was undertaken for the purpose of determining the effect of different temperatures on the rooting of Meloir Begonia leaf cuttings. In this experiment the larger, average-sized leaves were used. The constant temperatures maintained in the sand were 55°, 65°, 75°, and 85° F. The atmospheric temperature varied from 50° to 60° F. Two separate lots of cuttings were kept at each of the above temperatures. One lot in each treatment was kept under a glass-covered case. The case was made six inches in height and placed on the bench over each lot of cuttings. The purpose of the case was to maintain a high percentage of humidity around the cuttings.

It will be necessary to repeat the experiment before conclusions can be

drawn, but the data secured to date indicate that a temperature of 65° F. within the medium is most conducive to root development.

It is the general concensus of opinion among carnation growers that the best plants result from cuttings taken midway on the growing shoot of the parent plant; that is, neither too near the terminal end or too near the basal end of the plant. There is some evidence to show that this opinion is not well founded and that there is little difference in the total yield of plants grown from cuttings taken near the top, at the center, and near the base of the plant. The purpose of this experiment was to determine if this evidence would hold under North Carolina conditions. During the year 1933-34 fifty cuttings were taken from each of the following locations on plants of the variety White Matchless:

3 nodes from the flower bud
4 nodes from the flower bud
5 nodes from the flower bud
6 nodes from the flower bud
7 nodes from the flower bud
8 nodes from the flower bud
Immature flower shoots
Shoots from the base of the plant near the ground

From these cuttings twenty to twenty-four plants were grown from each lot and careful records were kept of the behavior of these plants with respect to rate of growth and yield of flowers per plant.

It will be necessary to repeat the experiment before conclusions can be drawn, but the data secured to date indicate that plants grown from cuttings taken at the third, fourth, fifth and sixth nodes produce the highest average yield per plant, 11.7, 7.4, 8.6 flowers, respectively, per plant.

As a part of the investigation on the propagation of carnations, a study was made of the effect of different temperatures on the rooting of carnation cuttings. Constant temperatures of 55°, 65°, 75°, and 85° F., respectively, were maintained in the rooting medium by means of thermostatically controlled electrical heating units. The atmospheric temperature varied from 50° to 65° F. Two separate lots of cuttings were kept at the above temperatures, except in the 75° and Check, or "No Bottom Heat" treatments. One lot in each treatment was kept under a glass-covered case, except in the 75° and Check treatments. The case was made six inches in height and placed on the bench over each lot of cuttings. The purpose of the case was to maintain a high percentage of humidity around the cuttings.

Sufficient data have not as yet been collected to justify the drawing of any conclusions, although the data secured to date indicate that a temperature within the medium of 55° to 65° F. is most satisfactory.

A study was made of the effect of different temperatures on the rooting of chrysanthemum cuttings. Constant temperatures of 65°, 75° and 85° F. respectively, were maintained in the rooting medium by the same means as in the carnation experiment described above. The rooting medium used was pure sand. The varieties Pink Doty and White Doty were used and cuttings made according to the usual methods. All of the cuttings in this experiment rooted one hundred percent.

Shrubs.—A study was made of the comparative value of pure sand with no bottom heat, pure sand with bottom heat (85° F.), and a mixture con-

sisting of equal parts by volume of peat and sand with bottom heat (85° F.) in the rooting of cuttings of the following species of ornamental shrubs: Abelia grandiflora, Cotoneaster horizontalis, Elaeagnus pungens reflexa, Hypericum prolificum, Jasminum nudiflorum, Ligustrum japonicum, Lonicera fragrantissima, Lonicera tartarca lutea, Punica granatum, Pyracantha coccinea, and Spirea bumalda (Anthony waterer). The cuttings were made on June 27 and 28, 1935, and the results were recorded on July 31, 1935. That atmospheric temperature in the propagation house varied from approximately 70° to 90° F.

The results of the one experiment indicate that pure sand with no bottom heat gives the best results with practically every species. (G. O. Randall and J. G. Weaver)

III. HUMAN FACTORS IN AGRICULTURE

Farm Family Relationships.—During the past year very little work has been done on this project because of the increasing interest and emphasis on other problems. We did, however, with the use of F.E.R.A. student labor carry on a considerable amount of tabulation, the object of which was to determine the correlation between replies of 50 personality and home back-ground questions answered by public school children. Correlation between questions of an objective nature was found to be relatively high, but there was a surprisingly low correlation found between questions of a subjective nature. This project is being continued, however, during the coming year. It is our plan to liquidate it as fast as its results can be efficiently summarized. (C. H. Hamilton)

Recent changes in the social economic status of farm families.—The objectives of this project were presented in our last annual report. The status of this project is as follows:

1. **Field work:** Complete. Comparable records were obtained not only from 1144 households in Enfield township, Halifax county, but also from 1703 families. In selected townships or sections of townships of the following counties: Johnston, Robeson, Rutherford, Richmond and Caswell.

2. **Editing:** All of these records have been carefully edited.

3. **Tabulation:**
   (a) Tenure and occupational changes—tabulation complete and tables prepared.
   (b) Changes in the income and farm organization—Tabulation complete and tables prepared.
   (c) Changes in indebtedness—tabulation complete and tables prepared.
   (d) Tenant and laborer shifts to and from owner farms—tabulation complete and tables prepared.
   (e) Reasons for tenure and occupational changes—reasons are being copied from schedules and are in process of being classified.
   (f) Expenditures and major items in the farm and family budget—tabulation complete and tables prepared.
   (g) Trends in ownership in livestock and poultry—tabulations complete and tables prepared.

(h) Birth rate trends—tabulation approximately one-half complete, other tabulation in progress.

(i) Marriage and migration trends of rural youth—tabulation approximately one-half complete and tables in preparation. Further tabulations being carried on by Hollerith machines.

4. **Mapping:** Each area studied has been mapped and all homes surveyed have been spotted on the maps at least within one-tenth of a mile of their actual location. About one-half of the final maps to be used in publication of the results have been prepared. Others will be prepared during the coming year.

5. **Preparation of reports:** One preliminary report has been prepared summarizing the results of the Recent Change study. A permanent report is to be prepared as soon as possible. A brief summary of the outstanding findings are shown in another section of this report.

Farm tenantry changes: During the depression years of 1930, 1931, and 1929, there was a definite shift down the "agricultural ladder" of many North Carolina families. Beginning, however, slightly in 1933 but significantly in 1934, there was a definite turn for the better. Farm renters began to shift into the owner class. Croppers and laborers began to shift into the renter class. The shift down the "agricultural ladder" during the years 1934 and 1935 was noticeable but more than overbalanced by the shift up the ladder during those years. Even in the so-called prosperous years before the depression there was a considerable shifting up and down the "agricultural ladder".

Changes in farm income in relation to tenantry: The percentage increase in farm income—net and gross—of tenants and croppers during the past two years was apparently just as great as that of farm owners who operate their farms. There is some evidence, however, that large absentee landlords have fared best under the Agricultural Adjustment program during the past two years.

Ownership of livestock and poultry in relation to farm tenantry: Both tenant and owner groups increased their ownership of livestock and poultry during the past two or three years. For instance, in the case of milk cows, the percentage of renters in 1935 owning milk cows was 73.3, as compared with only 60.0 percent in 1932. The corresponding percentage for croppers was 40.6 in 1932, and 56.7 in 1935; and the corresponding percentage for farm owners was 75.9 in 1932, and 80.6 in 1935. A similar picture is shown for chickens and other livestock, with the exception of swine.

Mobility of tenure groups: Although farm laborers, croppers, and renters move more often than do farm owners, there is no evidence that the amount of mobility has increased or decreased during the past few years. In most cases relief families move more often than do non-relief families, but this was reversed in the case of farm laborers. Farm laborers on relief in 1934 seem to be less mobile, not only during 1934 but during previous years, than non-relief farm laborers.

Migration and marriage rates of rural young people: During the Depression our studies show that the offspring of rural families did not leave home and get married in as large numbers relatively as before the

depression. The rate of migration and marriage during the worse years of the depression was about one-half of the rate just preceding the depression. In the last two years, however, the rate of migration from home and marriage of these young people has risen from 20 to 25 percent above normal. (C. H. Hamilton)

Human and social factors in soil erosion.—This project was carried on in cooperation with the Tennessee Valley Authority. Its objectives were:

1. To determine the human and social factors involved in soil erosion and its control.

2. To determine the human and social conditions associated with soil erosion. That is to say, the social and human cost of soil erosion.

The field work, analysis, and report of this project have been completed. The report is based on a survey of 592 households in the Cranberry-Hughes area of Avery county, North Carolina, as well as upon certain general information obtained from local sources in Avery county and other studies made in the area. Three copies of this report were prepared. One was submitted to the Tennessee Valley Authority; a second is on file in the office of the Director of the North Carolina Agricultural Experiment Station; and a third is on file in the Division of Rural Sociology.

A definite and high correlation was found between the type of population and soil erosion. Families living in the worse eroded lands were found to be limited with respect to human resources, education, standards of living, non-agricultural sources of income, ambition, energy, and general social outlook. The percentage of families on relief was found to be higher on eroded land. Farm tenancy was found to be associated with soil erosion. It was also concluded from this study that any program to control soil erosion must first take cognizance of the human and social relationships involved. The educational and economic status of these families on eroded lands must be improved along with soil conservation. (C. H. Hamilton)

Cooperative Rural research.—During the past year a plan of cooperative rural research was effected between the Agricultural Experiment Station, the Federal Emergency Relief Administration, and the North Carolina Emergency Relief Administration. Two major projects were carried on under this plan during the past year. (C. H. Hamilton)

A study of the Agricultural Adjustment Program in relation to rural relief needs.—This project was so planned as to supplement our study of Recent Changes in the Social and Economic Status of North Carolina Farm Families. A report of its progress insofar as the Experiment Station is concerned may be considered identical with that of the Recent Changes Study. A brief summary of the findings of this project, however, has recently been mimeographed. Results of this study have proven to be very useful to administrators of relief and of the Agricultural Adjustment programs. (C. H. Hamilton)

Current changes in the rural relief population.—This project is national in scope. Its purpose is to determine month by month the number of characteristics of relief cases in rural areas of the United States. Four-

teen North Carolina counties have been selected as a representative sample of the state. Statistical cards for a 50 percent sample of all relief cases in each sample county are filled out for a base month. In subsequent months cards are filled out for all closed cases in the sample and for all new reopened cases. A statistical summary of relief trends is prepared by the F.E.R.A. about three times each year on the basis of the data collected. Brief state summaries are also prepared in each state.

The Agricultural Adjustment Program has not substantially reduced the rural relief load in North Carolina, mainly because rural families on relief for the most part fall into the following classes:

1. Families who do not and never have lived in the cash crop areas where the Agricultural Adjustment Program has done the most.

2. Rural families who live as non-farm laborers in the small rural industrial and business centers. Many of these rural families not only have little farm experience, but also have no adaptability for or interest in farming.

3. Another class of rural families on relief are those in cash crop areas who are for one reason or another handicapped physically, mentally, or socially. This group includes broken families having no male workers between the ages of 16 and 64.

4. Farm families having poor and inadequate land resources.

It was found that a very small and insignificant number of the active rural relief cases were thrown on relief as a result of violation of the cotton adjustment contract. As a matter of fact, there has been a greater shift into than out of agriculture, even of relief families, during the past few years. (C. H. Hamilton)

Methods and practices of cooperative associations.—A body of information has been assembled relative to the methods and practices of cooperative associations in this state. During the past year two special studies have been made, one of the Cary Poultry Association, and the other of the Durham Mutual Exchange. The purpose of this study was to determine the factors affecting the success of the organizations. A schedule was prepared and used in the field to obtain information directly from the patrons of these cooperative associations. The information collected has not as yet been analyzed but a preliminary study shows that the information will be valuable in strengthening the cooperative associations now operating in the state.

To this study may be traced, at least a part of the progress which has been made in the state in cooperative buying and selling of farm products. Out of this project has developed the organization known as the Farmers Cooperative Exchange, which is making remarkable progress in this field.

In 1934-35 this project was temporarily suspended, due to the resignation of Dr. Joseph G. Knapp. It is planned, however, to analyze the material collected and publish a formal report in 1936.

A study of changes in taxes levied upon farm real estate in North Carolina from 1913 to 1935.—Work on this project was begun in 1932. Information has been collected on taxes levied on real estate from 1913 to 1920 on 213 farms. From 1920 to 1935 the number of farms has been

increased to 805, and the number of counties represented from 20 in 1913 to 51 in 1935.

Between 1913 and 1920 the tax rate per acre increased from 26 cents to 42 cents. For this same period the rate per $100 of assessed valuation of farm property declined from $1.01 to $.69. After 1920 the rate per acre continued to advance to about 80 cents in 1927. After 1927 the tax rate per acre declined steadily, reaching 40 cents in 1935. In a similar manner the tax rate per $100 of assessed valuation increased from 69 cents in 1920 to $1.72 in 1927, and then declined to $1.10 in 1934. The rate in 1935, however, was $1.31.

An analysis of the trends in tax rates by counties, more particularly from 1920 to 1935, is being made. It is also planned to relate the tax rates to changes in the price of important farm commodities. As taxes must be paid from income, tax rates probably should be adjusted to anticipated farm returns. The study will include, therefore, a discussion of ways and means by which the tax burden on farming can be somewhat more closely related to changes in the income of the farmer.

A related study of taxation has been in progress covering the period from 1920 to date. This study has had as its objective the determination of the net cash income of agriculture as a whole, and the relationship of the total taxes on agriculture to this net cash income. In the last annual report a summary of the results of this study was published. This summary showed that the net cash income varied from approximately 250 million dollars in 1920 to about 58 million dollars in 1932. During this same period the taxes increased from about seven million dollars to 14.5 million in 1927. Between 1927 and 1933 taxes tended to decline, reaching in the latter year $5,387,643. With the gradual decline in income and the increase in taxes, the taxes levied absorbed a higher percentage of the net cash income. Taxes in 1920 represented 2.79 percent of the net cash income, while in 1932 they represented 14.6 percent of the net cash income.

The trend since 1932 in net cash income has been decidedly upward. In 1932 the net cash income was $57,641,000, in 1935 the net cash income will be approximately $176,606,000. Taxes on farm property, on the other hand, have not advanced as rapidly with the result that taxes at the present time are absorbing only slightly more of the farmer's net cash income than they did in 1920. These data, therefore, would indicate that farming is recovering rapidly and that taxes are being maintained at a relatively low level. It will be interesting to watch the future behavior of net cash income and taxes levied on farm property in this state. And this information should furnish the basis for the adjustment of taxes to income much more readily and quickly than has been done in the past. (G. W. Forster)

IV. FINANCIAL STATEMENT

The following is a certified statement of the receipts from the Treasurer of the United States, supplementary funds from the State Department of Agriculture, and sales from the Station farms, with a record of their disbursements:

The North Carolina Agricultural Experiment Station,
in account with the United States Appropriations, 1934-35.

Dr.	Hatch Fund	Adams Fund	Purnell Fund
Receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1935; under acts of Congress approved March 2, 1887 (Hatch Fund), March 16, 1906 (Adams Fund), and February 24, 1925 (Purnell Fund)	$ 15,000.00	$ 15,000.00	$ 60,000.00
Cr.			
Personal services	12,055.22	12,549.79	46,333.98
Supplies and materials	668.10	984.85	6,438.23
Communication service	83.73	15.57	62.98
Travel expenses	1,080.05	574.65	3,739.27
Transportation of things		12.11	107.43
Printing and illustrating publications	189.04		279.32
Heat, light, water and power			108.20
Contingent expenses			16.91
Equipment	923.86	863.03	2,548.41
Buildings and land			365.27
Total	15,000.00	15,000.00	60,000.00

The North Carolina Agricultural Experiment Station, In account with Farm and Miscellaneous Receipts.

Dr.

State Department of Agriculture	$ 28,159.99
Sales	11,411.75
Special endowments, industrial fellowships, and similar grants	4,925.30
Emergency funds (C. W. A., etc.)	7,152.46
Miscellaneous	3,060.55
TOTAL	$ 54,710.05

Cr.

Salaries	$ 16,229.62
Labor	14,846.79
Stationery and office supplies	627.96
Scientific supplies, consumable	296.68
Feeding stuffs	3,532.99
Fertilizers	1,744.29
Sundry supplies	1,861.86
Communication service	645.94
Travel expenses	5,905.21
Transportation of things	154.31
Publications	51.62
Heat, light, water, power	129.40
Contingent expenses	2,291.95
Furniture, furnishings and fixtures	622.60
Library	46.88
Scientific equipment	114.30
Tools, machinery and appliances	615.00
Livestock	935.85
Buildings and land	996.25
Unexpended balance	3,060.55
	$ 54,710.05

We, the undersigned, duly appointed auditors of the expenditures from Federal appropriations reported herein, do hereby certify that we have examined the books and accounts of the North Carolina Agricultural Experiment Station for the fiscal year ended June 30, 1935, that we have found the same well kept and classified as above; and that the balances, receipts, and disbursements are as follows:

	Hatch Fund Act of Congress March 2, 1887	Adams Fund Act of Congress March 10, 1906	Purnell Fund Act of Congress February 24, 1925	Totals, All Funds
Unexpended balance brought forward from preceding year	None	None	None	None
Receipts for the year from the Treasurer of the United States	$ 15,000.00	$ 15,000.00	$ 60,000.00	$ 90,000.00
Total Federal funds	15,000.00	15,000.00	60,000.00	90,000.00
Disbursements for the year	15,000.00	15,000.00	60,000.00	90,000.00
Unexpended balance June 30, 1935	None	None	None	None

Proper vouchers for all of the above disbursements are on file and have been examined by us and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, March 16, 1906, and February 24, 1925, and in accordance with the terms of said acts, respectively.

(Signed) R. Y. WINTERS,
Director of the Experiment Station

A. F. BOWEN,
Financial Officer of the Institution
Auditors.

Attest:

A. F. BOWEN,
Custodian of the Seal.